BNC User's Manual

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Contents

1. Introduction to the BNC UNIT 4
General Features and Functions 4
Options 4
Front Panel Overview 5
Rear Panel Connections 7
2. Getting Started 9
System Requirements 9
Unpacking the BNC UNIT 9
Initial Inspection 9
Starting the BNC UNIT 9
Applying Power 9
Connecting to LAN 10
Direct connectivity to host via Ethernet cable (no router) 10
Connecting though USBTMC 10
Installing the BNC UNIT Remote Client 10
Troubleshooting the LAN Interconnection 10
Shutting Down the BNC UNIT 11
3. Using the Graphical User Interface (GUI) 12
Start the BNC UNIT GUI 12
Simultaneously controlling Multiple Signal Generators from one PC 13
Network Configuration 13
Perform Firmware Upgrade 13
Store and Load Instrument States 14
Setting the GPIB Address 14
Using Toolbars 14
Basic CW Operation 15
Sweeps 16
Frequency Sweep (Figure 7) 16
Frequency Linear Sweep 16
Frequency Log Sweep 17
Frequency Random Sweep 17
Power Sweep (Figure 8) 17
List Sweeps (Figure 9) 18
Modulation Control 22
Reference 26
Using the Trigger options (Figure 18) 27
LF OUT Control 29
Combined Modulation 30
4. Local Operation though Front Panel 31
Displayed Parameter Formats 32
CW Display 32
Main Menu Display 32
Frequency Sweep Submenu 33
Power Sweep Submenu 34
List Sweep Submenu 36

Modulation Submenu *37*
Pulse Mod Submenu *37*
Amplitude Mod Submenu *38*
Frequency Mod Submenu *38*
Reference Submenu *38*
Trigger Submenu *39*
LF OUTPUT Submenu *39*
LAN Configuration Submenu *40*
Display Settings Submenu *41*
Default Settings Submenu *42*
5. Programming the BNC UNIT 43
Using Sockets LAN *43*
Using and Configuring VXI-11 ..... *44*
Using SCPI for BNC UNIT *44*
Using Telnet LAN *44*
6. Battery Operation (B3 Option) 46
7. Extended Power Range (PE3 Options) 49
8. Maintenance and Warranty Information 50
Adjustments and Calibration *50*
Repair *50*
Safety *50*
Warranty Information *51*
Equipment Returns *51*
Company Details *52*

1. Introduction to the BNC UNIT

Your BNC UNIT Signal generator kit contains the following items:

- BNC UNIT mainframe
- Universal power adaptor (AC 100 – 240V) with UK, US, EU plugs
- Ethernet Cable
- BNC UNIT manuals & software CD

It is strongly recommended to use the original power adaptor (as supplied with the device) to guarantee save and reliable operation of the BNC UNIT.

General Features and Functions

The Berkeley Nucleonics BNC UNIT RF & Microwave Signal Generator offers:

- BNC UNIT 835-6: 9 kHz to 6100 MHz frequency range

  –30 to +13 dBm power levelled range , extendable to -120 dBm with option PE3.

  BNC UNIT 845: 100 kHz to 20'000 MHz frequency range

  -20 to + 13 dBm, extendable to -90 with option PE3.
- Modulation capabilities for FM, PM, AM and PULM modulation
- Fast frequency, power and list sweeps
- Light weight, optional internal rechargeable batteries (option B3)
- 3- inch status LCD
- Long-term support: Software upgrades (firmware and PC based) are available to download from www.Berkeley Nucleonics.com. You can also call our technical specialists for support. You can continue to use both of these services free of charge for the lifetime of the product.
- USB 2.0 device and host interface
- Universal LAN interface
- 18 months calibration cycle

Options

B3: internal rechargeable battery

PE3 for BNC UNIT 845: extended power range (-90 to +13 dBm)

PE3 for BNC UNIT 835-6: extended power range (-120 to + 13 dBm)

RM: 19'' rack mount kit

Front Panel Overview

The front panel contains a status display, a RF output female N-type connector, and a RF on/off key (Figure 1). The LCD screen shows information on the current function. Information includes status indicators, frequency and amplitude settings, current connectivity status, and error messages.

Figure 1 BNC UNIT Front Panel View (BNC UNIT 845)

RF On/Off button The **ON/OFF** key toggles between RF output on and RF output off. The green light (*) is indicating whether the RF output is enabled (light on) or not.

RF 50 Ω connector This female N- type connector (BNC UNIT 835-6) respectively female SMA connector (BNC UNIT 845) provides the output for generator signals. The impedance is 50 ohm. The reverse power damage level is +30 dBm maximum. The maximum allowed DC level is +/- 10 V.

Displayed Parameter Formats

Main LCD display

There are two parameters displayed in the main menu:

RF frequency in Hz (1st line) and

RF amplitude in dBm (2nd line).

On the 3rd line the lock status to an external reference source or enabled modulation format is displayed.

The 4th line provides remote connectivity status of the controlled source. The display is updated each time a value is changed.

Frequency - The current value for center frequency. Units: Hz

Range: 9'000 to 6'100'000'000 Hz (BNC UNIT 835-6) resp. 20'500'000'000 Hz (BNC UNIT 845)

Resolution: 0. 1 Hz

Amplitude - The current value for output power. Units: dBm

Range: -70.0 to +25.0 dBm (option PE3: -130.0/-90.0 to + 25.0 dBm)

Resolution 0.01 dB

Phase lock – External reference disabled, not locked or locked to pre-set value and enabled modulation settings.

Range: 1 to 200 MHz

Connectivity – Status indication - The current LAN IP address of the instrument or USB-TMC connection identifier.

Rear Panel Connections

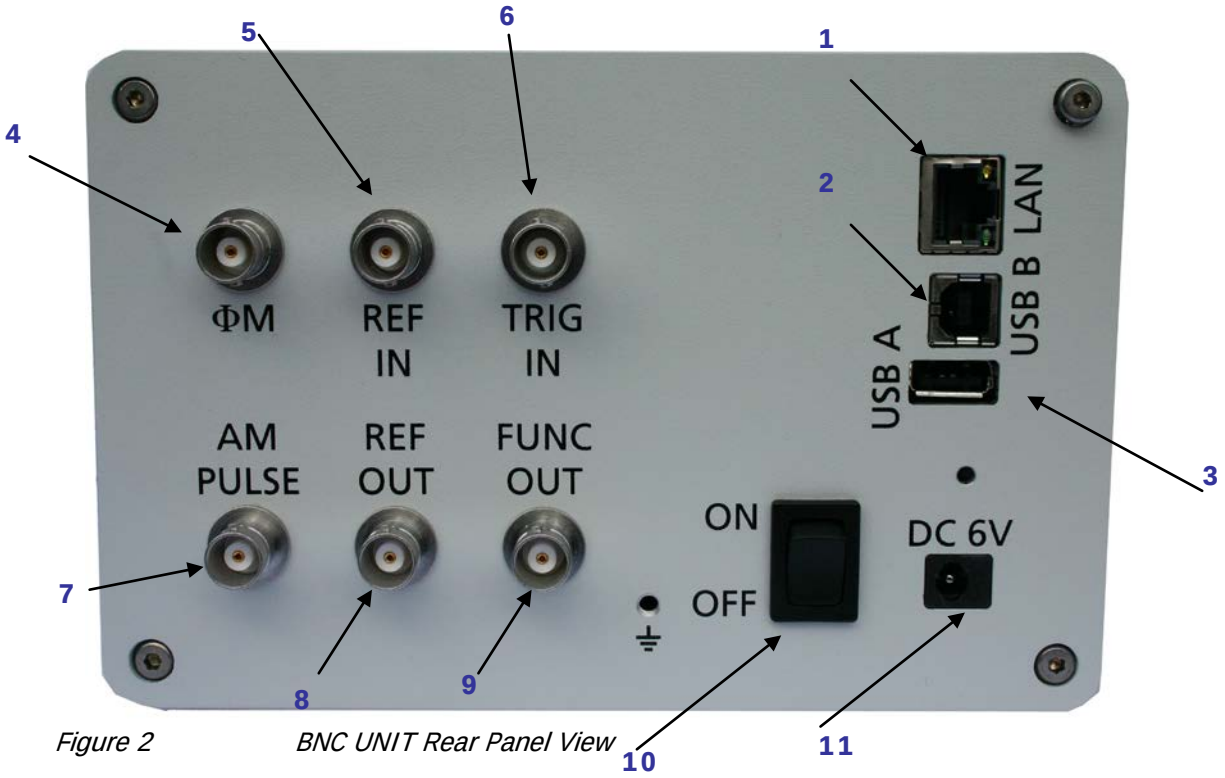


Figure 2 *BNC UNIT Rear Panel View*

1 RJ-45 host connector Used for connecting with a controller, such as a PC or Labtop.

2 USB Device Used for connecting with a controller, such as a PC or Labtop. Communication via USB-TMC protocol.

3 USB Host Used for connecting USB devices such as Memory sticks or USB-TMC power meters.

4 FM/PM MOD IN connector This BNC input connector accepts a 0 to 2 V (peak) signal for FM modulation. The damage level is 4 Vrms.

5 REF IN connector Female BNC connector, accepts a TTL or -5 to +15 dBm sine signal from an external reference oscillator that is within ±1 ppm of the programmed reference frequency. The nominal input impedance is 50 ohm.

6 TRIG IN connector Female BNC connector, accepts a TTL signal from an external trigger source. The input impedance is 1Mohm.

7 AM / PULSE MOD IN connector This BNC input connector accepts TTL signal for pulse modulation respectively analog voltage for AM. The damage level is 5 Vrms.

8 REF OUT connector Female BNC connector is for an output of the internal **10 MHz** reference frequency, which has a nominal output level greater than 0 dBm, and an output impedance of 50 ohm.

9 FUNCT OUT connector Female BNC connector is used as a multiple purpose output. It can be programmed as trigger output, as video output during pulse modulation, and as output for the low frequency function generator.

10 Power switch The power switch disconnects the signal generator from the DC input completely, including the internal high-stability reference. After switching on this switch, the signal generator enters into standby with the OCXO warming up and RF out switched off. The red power LED (option HC only) on the front panel is turned on.

11 DC IN power receptacle The power receptacle accepts a two-pin plug from the external 6 V DC power adapter

2. Getting Started

System Requirements

To ensure that your BNC UNIT signal generator operates correctly with the graphical user interface, you must have a computer with at least the minimum system requirements to run one of the supported operating systems.

Operating system Windows™ 2000 SP4, XP SP2, Vista, or Windows 7
Ethernet Port 10/100/1000M Ethernet

Unpacking the BNC UNIT

Remove the BNC UNIT materials from the shipping containers. Save the containers for future use. The standard BNC UNIT package includes:

1 Synthesized Signal Generator
1 Ethernet Cable
1 Universal DC power adapter
1 BNC UNIT Software & Manual CD

Initial Inspection

Inspect the shipping container for damage. If container is damaged, retain it until contents of the shipment have been verified against the packing list and instruments have been inspected for mechanical and electrical operation.

Starting the BNC UNIT

This section describes installation instructions and BNC UNIT verification tests.

Applying Power

1. Place the BNC UNIT on the intended workbench and connect the appropriate DC power supply to the receptacle on the rear of the unit. Make sure you use the included DC power supply. The BNC UNIT requires 6 V DC at 3 A maximum. **Using other supplies may lead to malfunction and damage of the BNC UNIT.**

2. Press the Line on/off switch on the rear panel. The front panel display will illuminate. The instrument will initialize, and momentarily display the model number, firmware revision and product serial number. The display will then switch to the factory default display setting, showing preset frequency (100 MHz) and power (0.0 dBm), phase lock status (internal reference) and instrument connectivity status (IP or USB identifier).

Connecting to LAN

Connect the BNC UNIT to your local area network (LAN) or directly to your PC/Labtop using the Ethernet cable. By default, the instrument is configured to accept its dynamic IP number from the DHCP server of your network. If configured properly, your network router will assign a dynamic IP number to the instrument which automatically will be displayed on the screen. Your instrument is now ready to receive remote commands.

Direct connectivity to host via Ethernet cable (no router)

If you want to connect the instrument directly to your computer (without router in the LAN), you must use an Ethernet cable with crossover (not required if your computer has Gigabit-Ethernet). To work properly, the network card (NIC) of your computer shall be set to a **fixed IP beginning with 169.**xxx.xxx.xxx. In general, connection with a NIC that is configured to use DHCP is also possible, but depending on the configuration the connection may take several minutes.

After a short time, the instrument will detect that no DHCP server is present and assign itself a default IP number 169.254.5.5. The instrument now must show 169.254.5.5 on the display. Should the IP not appear after more than 30 seconds, leave the LAN cable in place and turn the instrument off and then on again and retry.

Connecting though USBTMC

Connect the BNC UNIT to the PC using the USB cable. The PC must be configured with the Berkeley Nucleonics GUI with USB support installed. Alternatively, a VISA runtime environment (NI or Agilent, or comparable) must be installed. If connected properly, the computer will detect the BNC UNIT as a USBTMC device. You can use the GUI to connect directly or though VISA Write to send the *IDN? query and use VISA Read to get the response. The USBTMC protocol supports service request, triggers and other GPIB specific operations. The BNC UNIT remote client (graphical user interface) will detect all attached devices automatically.

Installing the BNC UNIT Remote Client

Berkeley Nucleonics's graphical user interface provides an intuitive control of the BNC UNIT. It runs under Windows™ operating system with minimum requirements. The DLL is embedded in the GUI application and requires the Microsoft® .NET™ framework to be installed. To install the GUI on the computer, insert the BNC UNIT Software and Manual CD into the CD/DVD drive. If the setup doesn't start automatically double click on the setup.exe to run the auto-installer.

The self-extracting setup provides easy installation and de-installation of the software. The setup program guides you in a few steps though the installation process. In case the .NET framework is not installed on your current Windows™ operating system, the setup procedure automatically will assist you to install the required version. For this you will need an active internet connection.

Troubleshooting the LAN Interconnection

Software does not install properly

- Make sure your installation CD is not damaged.
- When Microsoft .NET Framework is not installed make sure that your PC is to the internet connected during installation of the BNC UNIT Software. If no internet connection is available, install the .NET™ Framework that is available on the installation CD.

Software cannot detect any BNC UNIT

- Make sure you have connected both PC and BNC UNIT instrument to a common network.
- If a direct connection is used, make sure you use an appropriate crossover Ethernet cable (10 and 100Mbit LAN only). Note that detection of the BNC UNIT can take a considerable amount of time if your PC is configured to work with an external DHCP server. In some cases the connection may even fail completely. Use a fixed IP instead.
- Make sure that your software firewall enables the BNC UNIT software to setup a TCP/IP connection within the LAN. Under Windows XP you can do that like this:
  Open *Control Panel* under *Settings* in your *Start* menu. Then go to *Windows Firewall*. Click on *Exceptions* and then *add Program.* If the BNC UNIT Software is in this list choose it and click *OK* otherwise you have to browse for the path to Berkeley Nucleonics Software. Finally close all open dialogs with *OK*. Now your Windows™ Firewall is ready for BNC UNIT.

Shutting Down the BNC UNIT

Press the Line on/off switch on the rear panel to off.

3. Using the Graphical User Interface (GUI)

Berkeley Nucleonics's graphical user interface provides an intuitive control of the BNC UNIT. It runs under any Windows™ operating system. Make sure the software is installed correctly and the computer's firewall configured properly. The BNC UNIT dynamic link library (DLL) uses the Microsoft .NET framework.

Start the BNC UNIT GUI

Double-click the BNC UNIT shortcut that will appear on your desktop after the software has been successfully installed.

After start, the software will automatically detect existing BNC UNIT instruments. In the ***CONTROL*** tab (see Figure 3) the detected BNC UNIT Devices are listed. Clicking on one of the devices will instantly establish connection. Clicking on a different device will disconnect the old device, and connect to the selected device. By clicking on the **Scan Instruments** button, a scan for new devices is started. If you also look for devices connected via GPIB, select it by check it's box below the scan button.

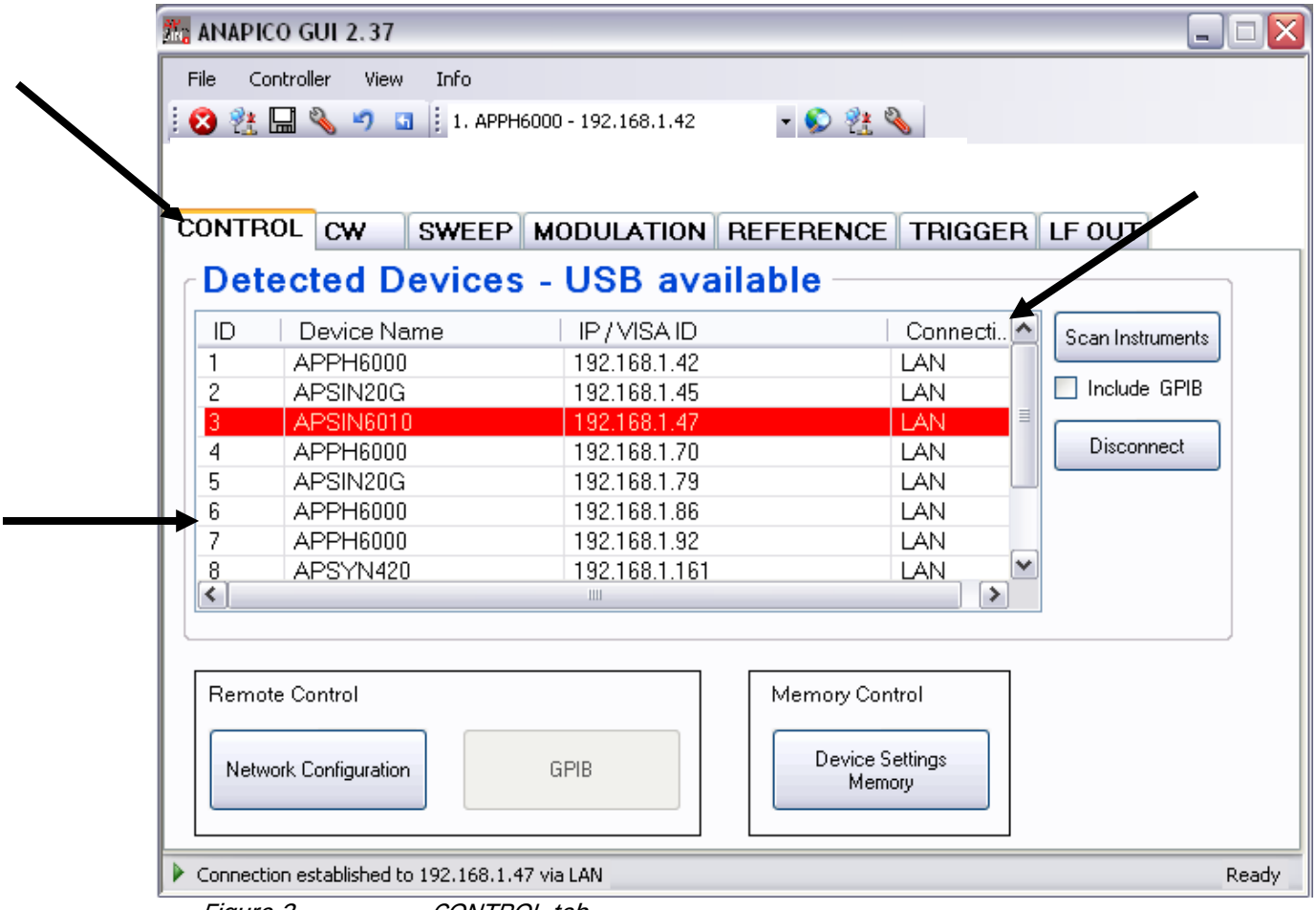


Figure 3 CONTROL tab

Alternatively, the IP address of an BNC UNIT instrument can also be typed directly at the lower right of the CONTROL tab.. This may be necessary if the instrument is working in a LAN environment, where broadcast massages are blocked and the GUI auto detect function may fail.

Simultaneously controlling Multiple Signal Generators from one PC

You can easily control multiple BNC UNIT from a single computer over the LAN connection, but you need to start a separate GUI for every instrument.

Network Configuration

If your network does not have a DHCP server or a static IP address is preferred, you can set an IP address, network mask and default route. The address and mask settings are required. The default route is not strictly necessary, but enables network communication between the test set and devices on a subnet other than that to which it is immediately attached. The network features can be used on the local area network, even if no default route (specified as 0.0.0.0) is configured.
The **Network Configuration** button allows configuring the LAN settings as shown in Figure 4. Using a DHCP (dynamic host configuration protocol) server can be enabled or a static IP can be entered by user. The device name can be modified as desired. The unit serial number and firmware revision are displayed on the bottom.

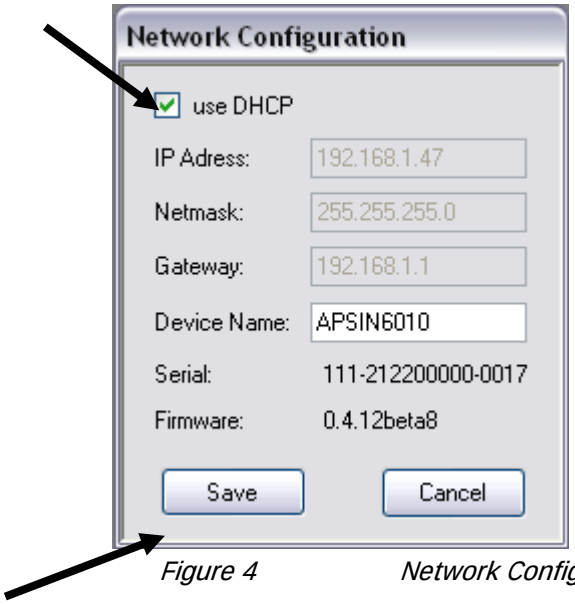


Figure 4 Network Configuration Submenu

Perform Firmware Upgrade

A firmware upgrade of the BNC UNITX000 can be done directly via the GUI. Make sure you are connected to the right device and have the correct binary ready. Then go to **Controller → Update Firmware** and select the appropriate binary that you have received from Berkeley Nucleonics or downloaded from the Berkeley Nucleonics website. The update will take a few seconds, and after completion the device will reboot. Reconnect to the device and continue using the device.

Store and Load Instrument States

Multiple different memory states are available to store instant instrument settings. By clicking on the **Device Settings** Memory button, the currently saved memory settings are displayed and can loaded or overwritten as shown in Figure 5. To modify or enter a state, click on the appropriate line and select if the current instrument settings shall be stored in or loaded from the selected memory state or.

Memory 0 is used as default state when the BNC UNIT is powered up.

The memory states can also be accessed via the front panel menu.

Setting the GPIB Address

If the instrument has the GPIB option installed, the GPIB address can be changed in the GPIB submenu in the control tab. Valid GPIB address are 1 to 30.

To verify GPIB functionality, use the VISA Assistant, available with the Agilent IO Library or the Getting Started Wizard available with the National Instrument IO Library. These utility programs enable you to communicate with the signal generator and verify its operation over GPIB. For information and instructions on running these programs, refer to the Help menu available in each utility.

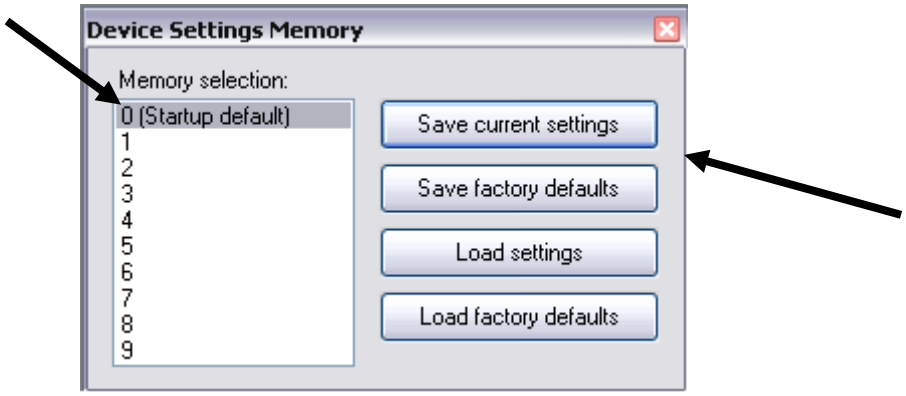


Figure 5 *Memory Settings Submenu*

Using Toolbars

In this Software Version there are two Toolbars available.

Standard toolbar:

Close the Application
Connect / Disconnect
Save to Memory
Network Configuration
Reset System
Restart Controller

Basic CW Operation

The BNC UNIT is a laboratory instrument designed to generate a synthesized CW signal with good spectral purity and variable amplitude. To set a desired frequency, relative phase and amplitude, click to the **CW tab** (Figure 6). The desired frequency, phase, and power can be set by clicking on the up and down arrows above and below each digit. The frequency is settable in steps of 0.001 Hz, the phase is settable in steps of 0.1 deg, and the power in steps of 0.1 dB.

The **RF ON/OFF button** turns the RF power on and off. The green LED in the RF ON button indicates that the RF output is enabled.

With the **MOD-ON/OFF-button** all current running modulations can be stopped or re-started.

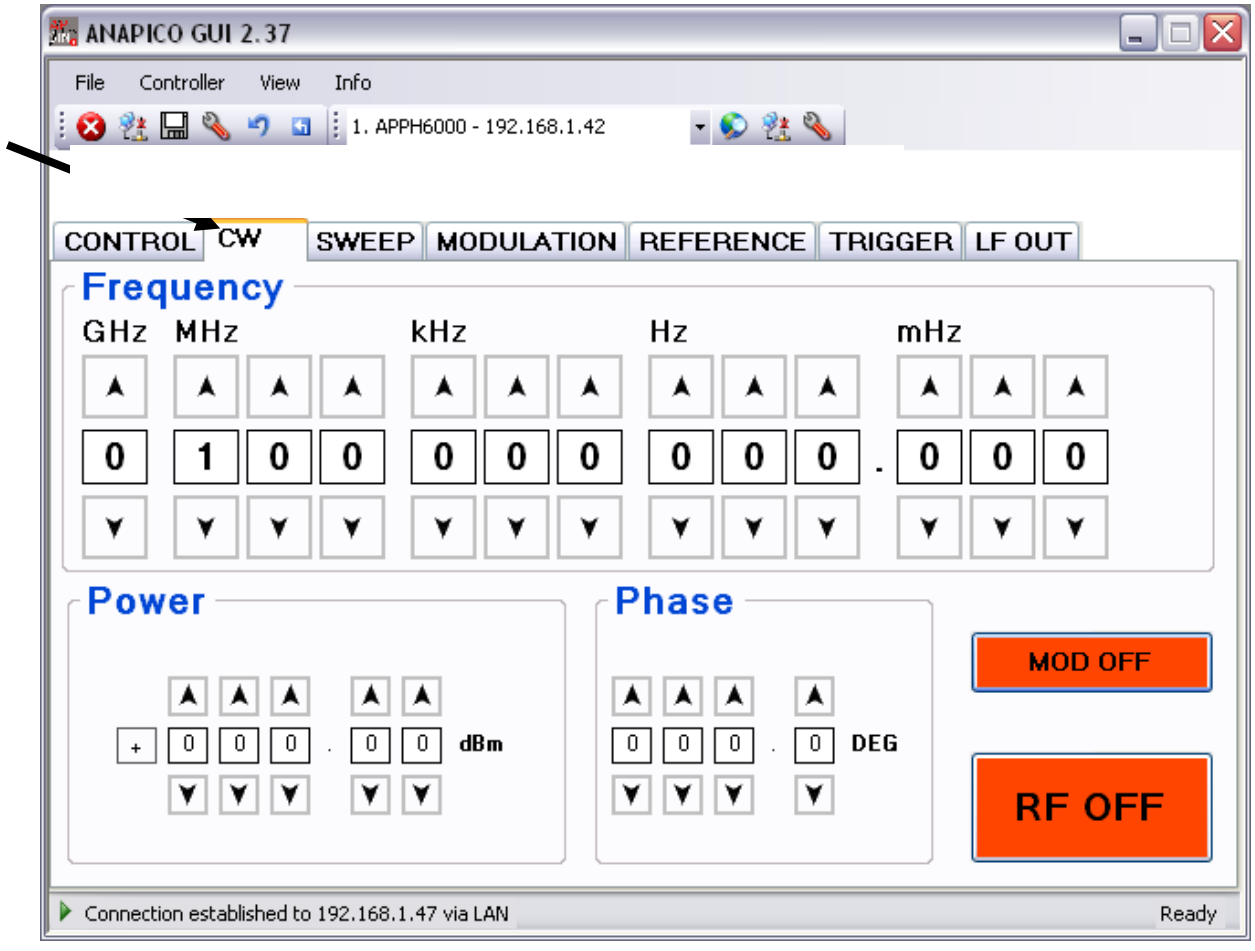


Figure 6 CW tab

Sweeps

Besides the basic CW operation, the BNC UNITX000 supports several frequency and power sweeping modes. Sweep parameters can be set in the **SWEEP tab** (Figure 7). Select frequency, power or list sweep by clicking on the **FREQ. SWEEP**, **POWER SWEEP, or LIST SWEEP tab**, respectively.

Frequency Sweep (Figure 7)

To start a frequency sweep,

a) enter start and stop frequency in Hz unit,
b) enter the number of points (or points per decade),
c) enter the dwell time in milliseconds (min. dwell time is 50 microseconds),
d) enter the off time in microseconds,
e) select the sweep mode as linear or log; additionally click “random” if random sequence is desired.
f) select the repetition mode: enter number of repetitions or choose “infinite”
g) select the ALC mode: on, hold or off. Generally, ALC on is used. If very short dwell times (1-2 ms) are needed, the ALC can be set to “hold”. This way the ALC loop is disabled during the sweep. The ALC voltages are calibrated before the sweep to maintain high level accuracy during the sweep.
h) press the on/off button.

The time resolution is 200 ns. Note that the sum of the dwell time and the off time must be greater or equal 1.0 ms. The dwell time must be at least 50 μs, the off time can be also be 0 (no off time). When “auto” is selected, the off time is automatically adjusted such that during switching transients the output is disabled and the sum of dwell and off time are at least 1.0 ms.

Under “repetition mode” you can select how many times the sweep should be executed by entering 1 to N times, or select infinite. Selecting “Rand” will sweep the frequencies in a random manner until terminated by user. In all cases the frequency returns to the CW frequency as soon as the sweep is terminated.

Start and stop the sweep by pressing the **ON/OFF button**.

The switching transient between frequency steps depends on the step size and if internal bands of the synthesizer are crossed. Typical switching transients are <10 μs for a <100 MHz step (no band crossing) and <50 μs for arbitrary steps at output frequencies >143 MHz. Transients of 100 μs can be noticed for arbitrary steps at output frequencies <143 MHz. Transients of 400 μs occur only when switching from above 400 MHz to a frequency below 400 MHz.

Frequency Linear Sweep

Sweeps linearly from start to stop frequency in constant steps. Frequency step size is (f_stop-f_start)/number_of_points. If start<stop then negative frequency steps are performed.

Frequency Log Sweep

Sweeps logarithmically from start to stop frequency in a given number of points per decade.

Frequency Random Sweep

The output frequency is selected randomly between start and stop frequency. The number of different output frequencies is determined by the number of points selected by the user.

Power Sweep (Figure 8)

To run a power sweep, enter start and stop power in dBm unit, the number of steps, dwell and off time in milliseconds. Dwell time is at least 50 μs, the sum of the dwell and off time must be at least 400 μs. When "auto" is selected, the off time is automatically adjusted such that during switching transients the output is disabled and the sum of dwell and off time are at least 400 μs.
Select, if the sweep should be run a predefined number of times (enter desired number) or infinite times (selecting infinite). Select ALC settings. Start and stop the sweep by pressing the **ON / OFF button**.

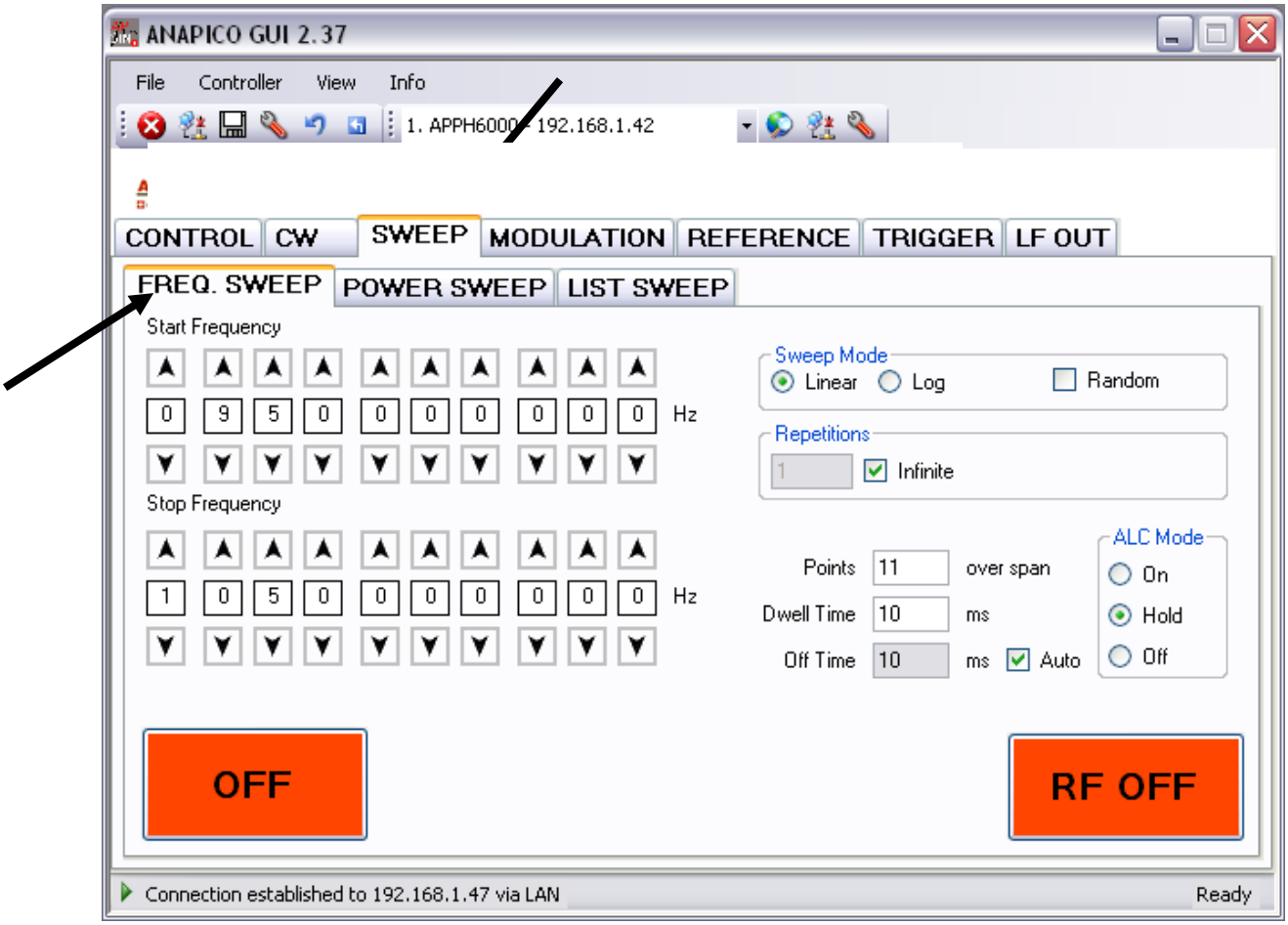


Figure 7 FREQENCY SWEEP tab

List Sweeps (Figure 9)

List sweeps allow to set frequency, output power, dwell time, and off time for each entry individually. To start a list sweep, the following steps are required:

a) select sweep parameter

b) select indexing

c) upload list file from computer (CSV-file) or load sweep from instrument flash memory or edit new list.

d) select number of repetition

e) select ALC mode: on, hold or off. Generally, ALC on is used. If very short dwell times (< 2 ms) are needed, the ALC can be set to “hold”. This way the ALC loop is disabled during the sweep. The ALC voltages are calibrated before the sweep to maintain high level accuracy during the sweep.

f) start sweep with on/off button

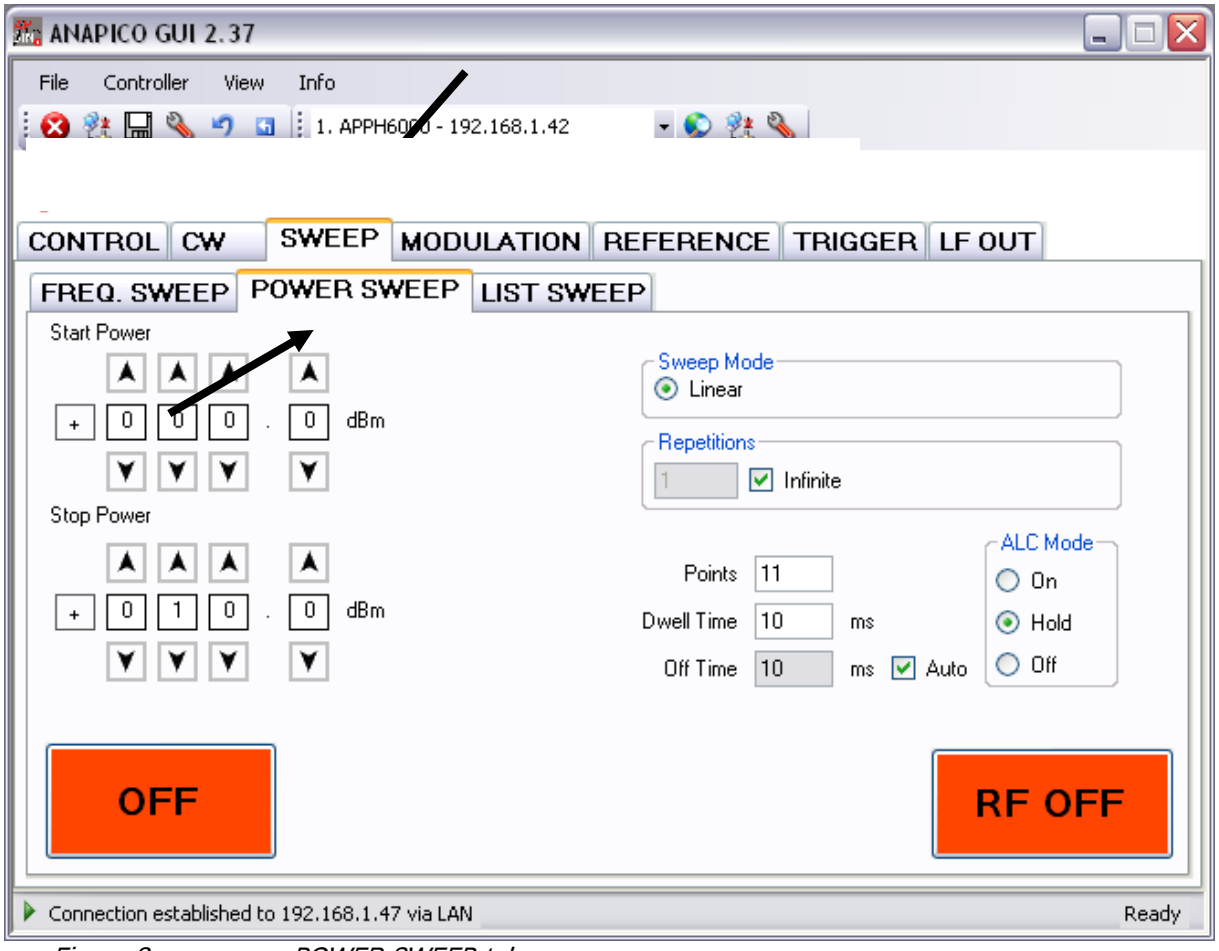


Figure 8 POWER SWEEP tab

You can select if you want frequency, output power, or both to be swept. If only one of the two parameters is selected, the second parameter is held constant during the sweep. The value is set to the value in line 1 of the CSV file.

You can choose the indexing of the list to go up, down, or be random. If you select random indexing, the index is randomly chosen for N times where N is the number of list points.

The input file must be a 4 column CSV file with the following syntax on each line:

frequency [in Hz]; power [in dBm]; dwell time [in µs]; off time [in µs]

Note the four entries in each line must be separated by a ***semicolon***.

Figure 10 shows a valid list file with four points displayed in Microsoft Excel. Each line describes one list point. The first line must contain all for entries, in any other line entries may be omitted. Lists may contain up to **10'000 lines**.

The dwell time must be at least 50 µs. The off time may be set to zero if the output is not to be disabled during transients. **The sum of dwell time and off time must at least** 500 µs**.** Transient times depend on the frequency steps and are typically less than 10 µs for a 100 MHz step.

The number of repetitions determines how many times the lists will be executed.

List sweeps can be directly loaded, edited and saved from the GUI. Press the List Memory button in the List Sweep Tab to open the list sweep editor as shown in Figure 11.

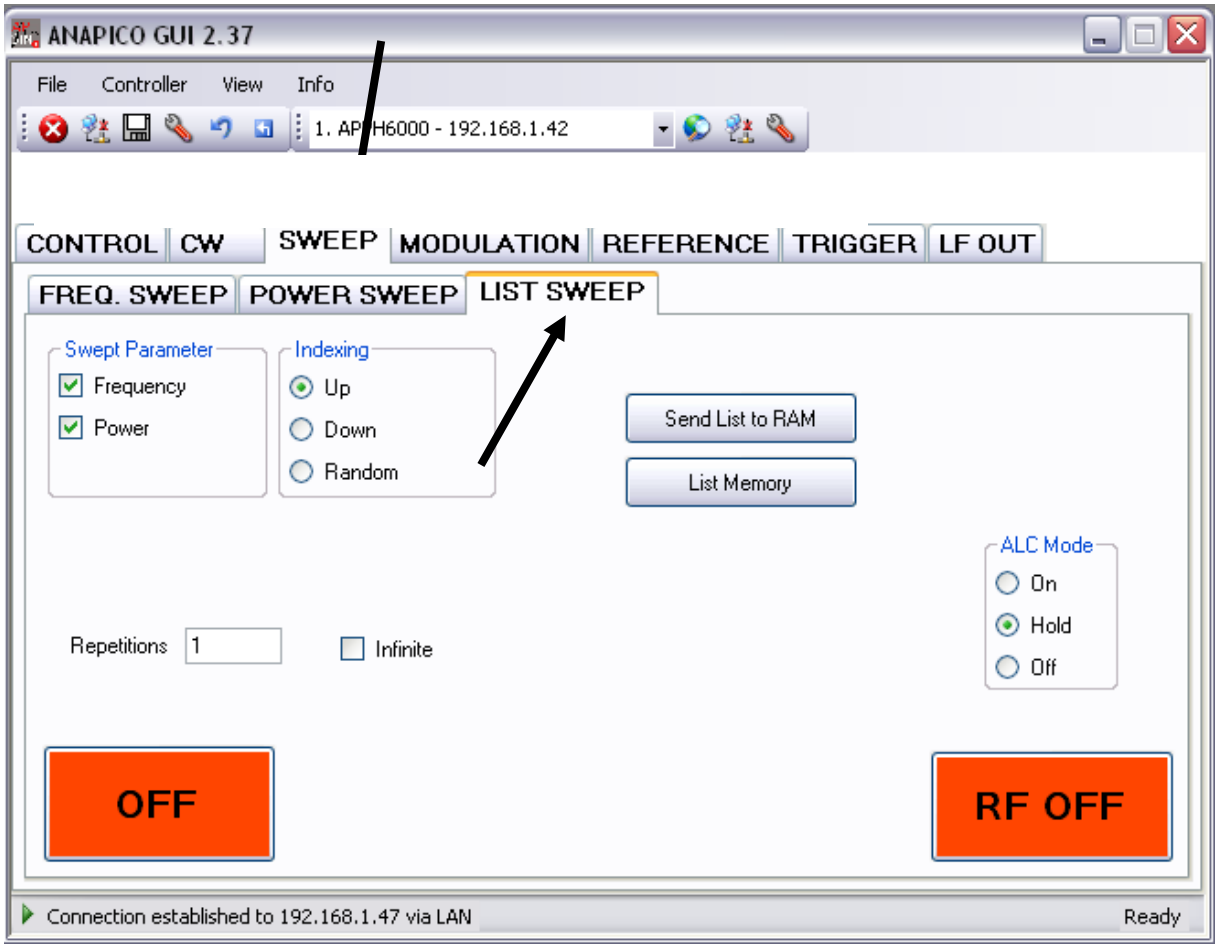


Figure 9 LIST SWEEP tab

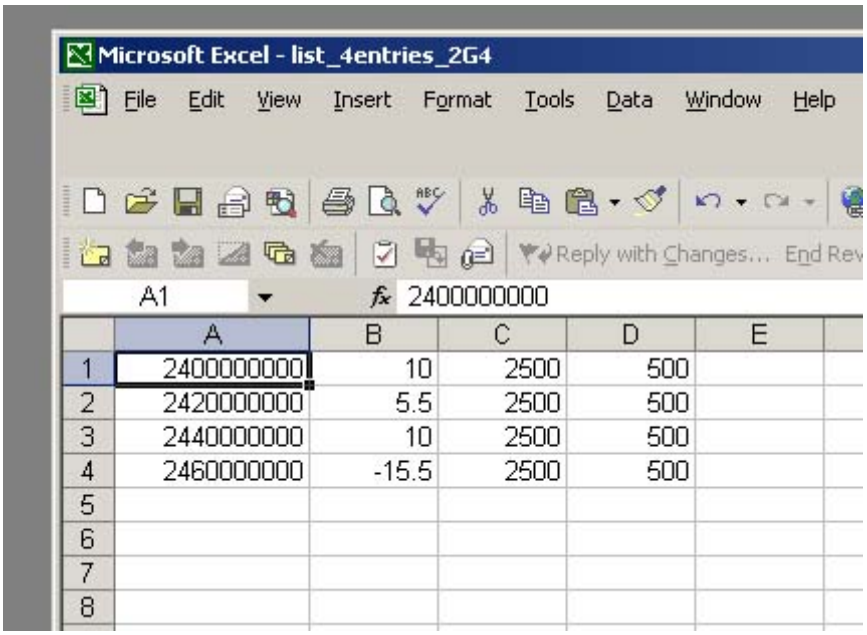


Figure 10 CSV-file with four points(1st column: frequency in Hz, 2nd: power in dBm, 3rd: dwell time in µs, 4th: off time in µs).Values must be separated by semicolon!

The editor consists of a table editor on the right, and the save and load functions on the left.

To create a new list, just enter the various frequency and power values in line 1 to N. You can also load an existing list sweep file (in CSV format) from the computer by using the Open list file button below.

After you have completed the list sweep, you can save the list either on your computer (Save list file button) or load it to the instrument (← Send button). Once loaded to the instrument, the list is the active list in the memory. To save the active list in the non-volatile memory on the instrument, you then enter a filename and press the **↓ Store button.**

If you want to locally edit an already stored list sweep from the instrument, you select the respective list sweep file (or memory) and press the → Get button.

The list sweep that shall be executed must be loaded into the Device list RAM by using the ← Send or ↑ Load buttons.

Confirm your selection with "Ok" to return to the List Sweep Tab and start the sweep with the ON / OFF button.

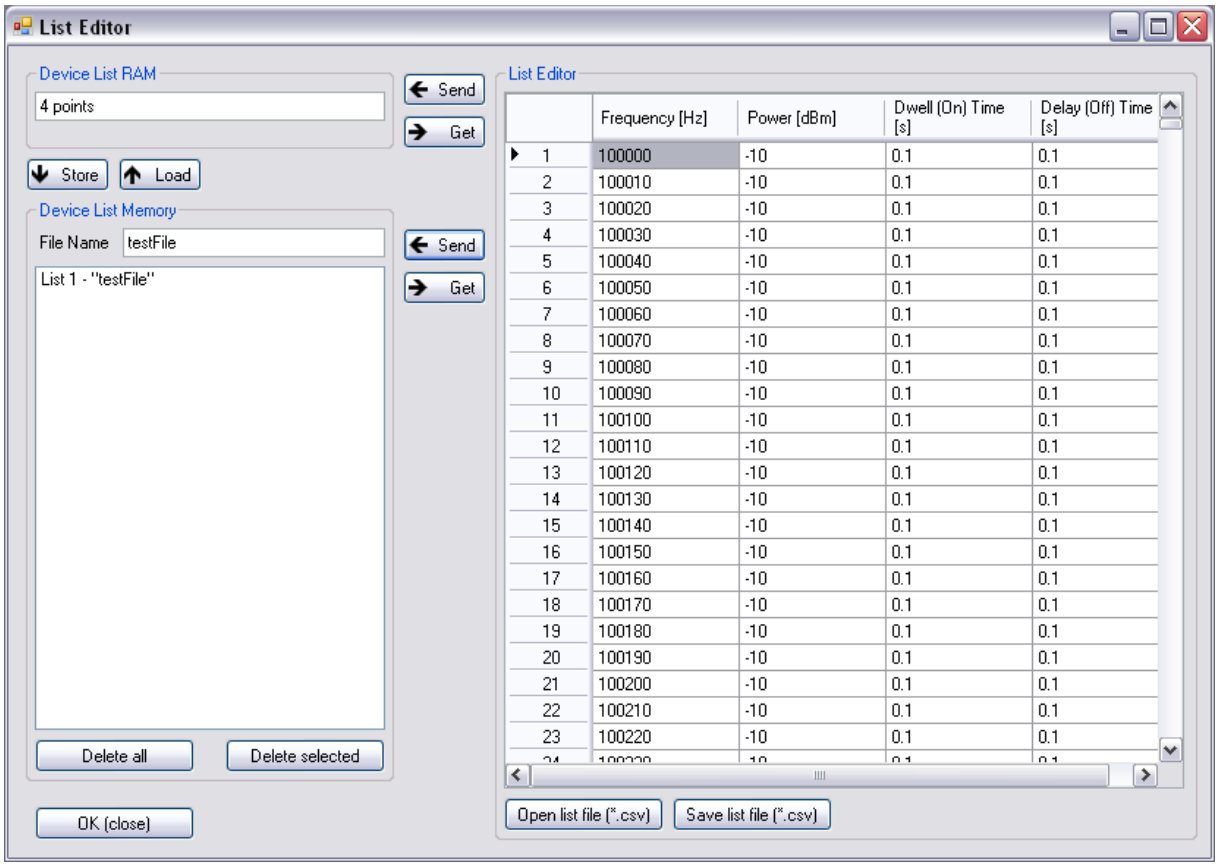


Figure 11 List Editor

Modulation Control

The BNC UNIT provides various modulation capabilities that can be accessed by the **MODULATION tab** (Figure 12).

PULSE MODULATION

On the left, **the internal pulse modulation** can be preset and started with the ON/OFF button. Enter pulse width and modulation period in milliseconds as required. Note that pulse width resolution and accuracy is approx. ±0.015 µs.

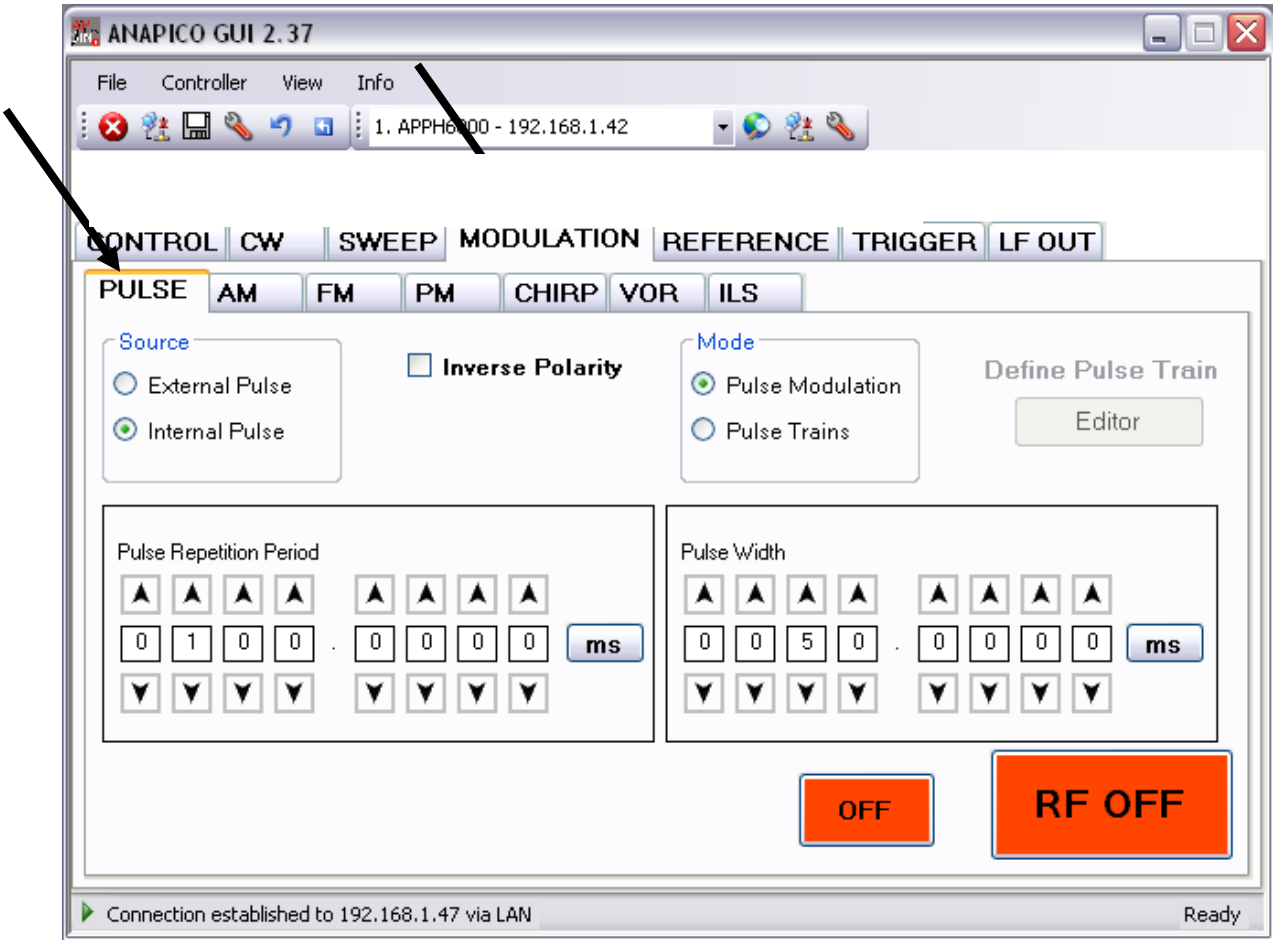


Figure 12 MODULATION tab for pulse modulation

PULSE TRAIN MODULATION

You can define **pulse train** sequences by using the editor (Figure 13). The editor will be available when mode is set to pulse trains. There are two input options: Hexadecimal string or select/unselect boxes of the binary representation. The maximal sequence length is 256 bits or 64 (hexadecimal) chars when using the GUI. Via remote programming sequences up to 4096 bits can be programmed. The pulse width and pulse period can be set in ranges of milliseconds or microseconds, selected by the button next to the digits (Figure 12).

For **external pulse modulation**, the **ext. Pulse Enable** must be checked. Invert the polarity of the external video signal by checking **Inverse Polarity**.

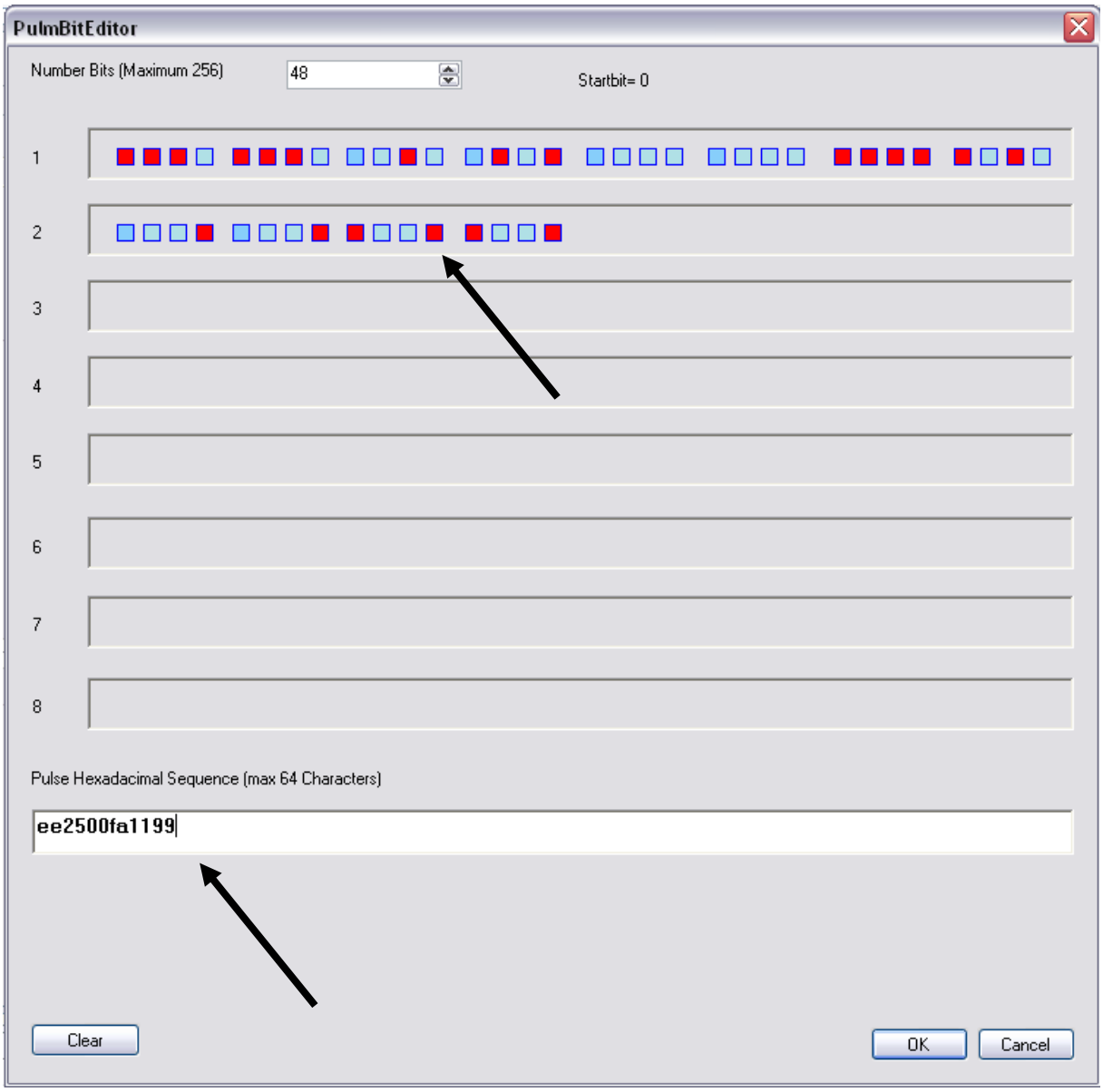


Figure 13 Editor for pulse trains

AMPLITUDE MODULATION

The **internal AM** (Figure 14) can be enabled by pressing the ON/OFF button in the AM portion of the submenu. Modulation depth can be selected from 1 to 99 %.

AM modulation rate can be set from 1 Hz to 50 kHz.

The internal function generator is used to provide the modulation signal. The shape can be set to sine or square.

External AM can be enabled with **ext. AM Enable.**

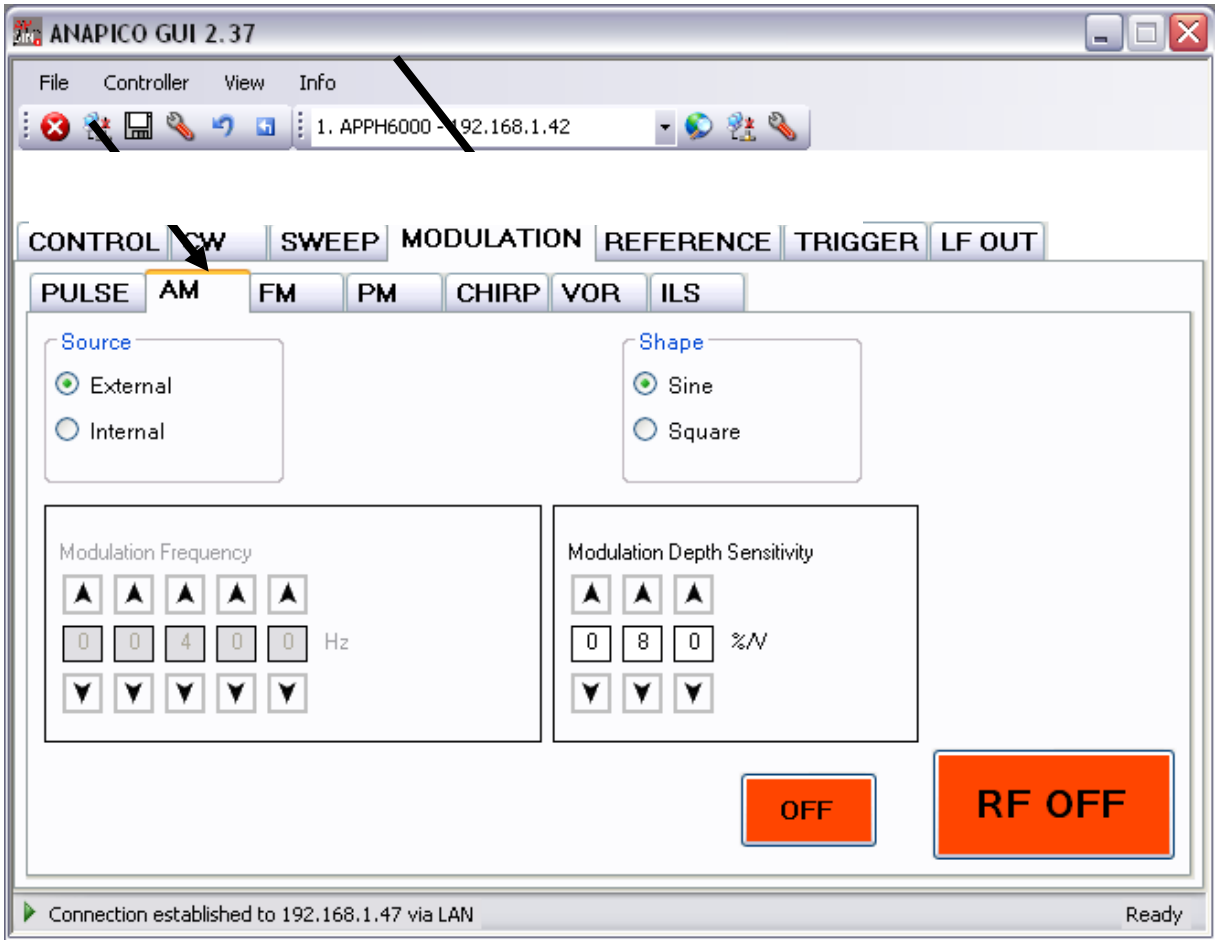


Figure 14 MODULATION tab for AM modulation

ANGLE MODULATION

The frequency and phase modulation settings can be accessed by selecting respective **FM and PM** tabs (Figure 15).

For **external angle modulation**, enter the desired sensitivity per Volt for either frequency or phase modulation and press the **ON/OFF button.** Connect source with external modulation signal at the rear BNC input.

To use the **internal FM modulation**, the modulation rate and deviation must be set in the appropriate fields.

The shape can be set to sine, square, triangle, ramp up or ramp down.

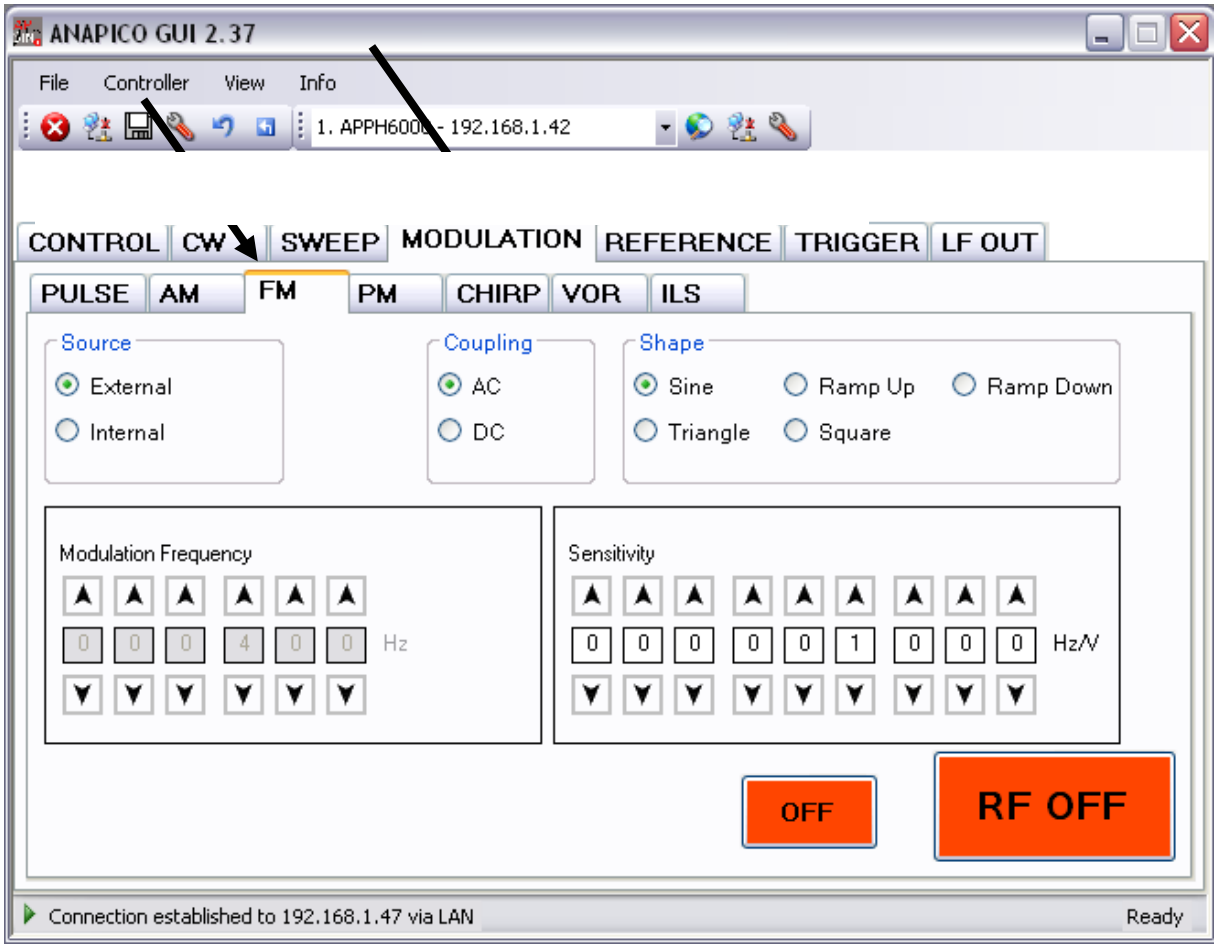


Figure 15 MODULATION tab for FM modulation

CHIRPS

Specify center-frequency and frequency-span for running chirps (Figure 16). For the chirp-time the range can be set to milliseconds or microseconds by the button next to the digits.

The chirp direction is either up, down or bidirectional (up first or down first).

The repetitions can be set from 1 to infinity. Note: The trigger must be set on the trigger tab.

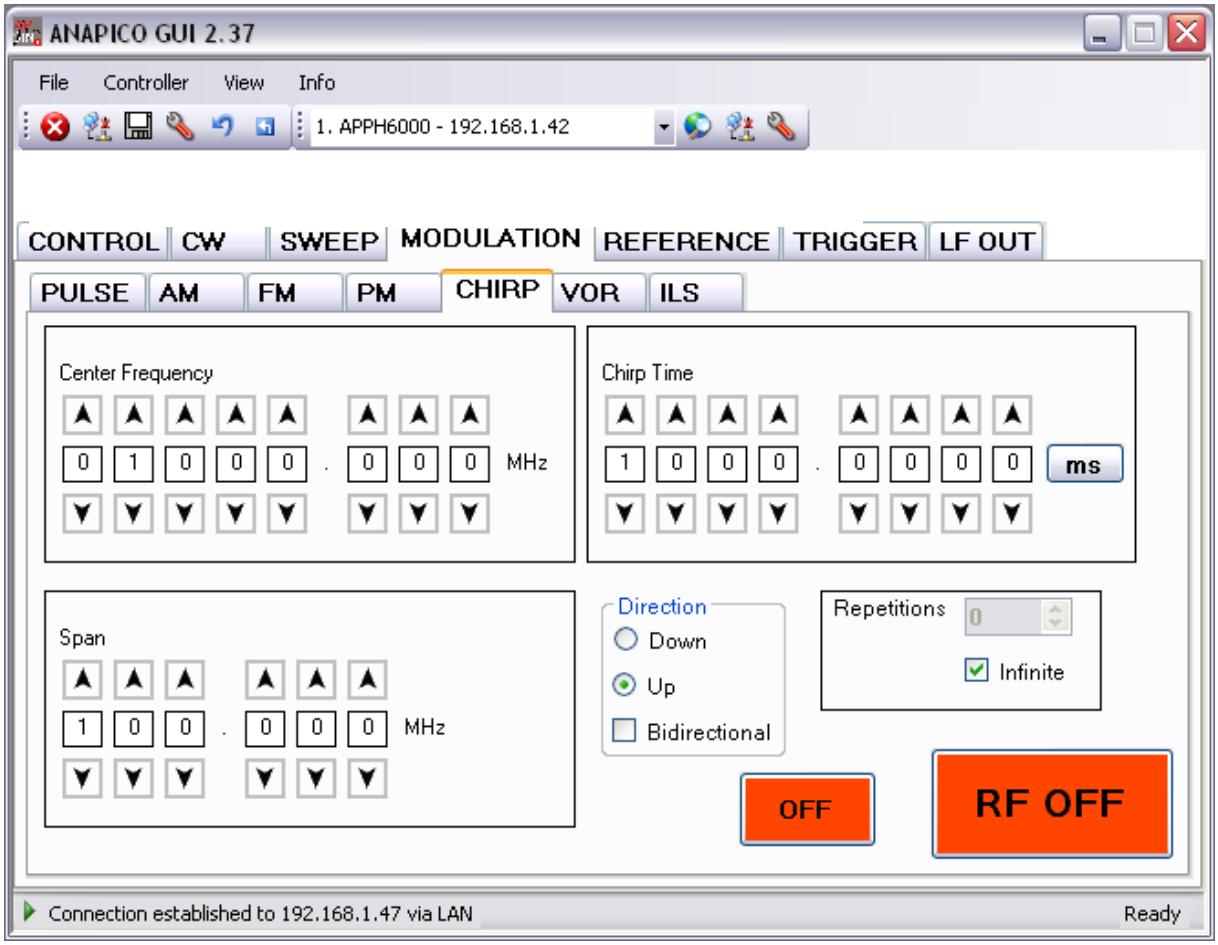


Figure 16 MODULATION tab for chirps

Reference

The BNC UNIT can be locked to an external frequency reference by connecting to the external reference input in the rear panel. To enable the external reference, go to the **REFERENCE tab** (Figure 14). Click **Use ext. reference** and enter the reference frequency. The reference frequency must be between 1 and 230 MHz and precisely known.. The lock status is shown as **Locked** (green color) or **Not Locked** (red color). Make sure that your reference has the required accuracy of < 1.5 ppm.

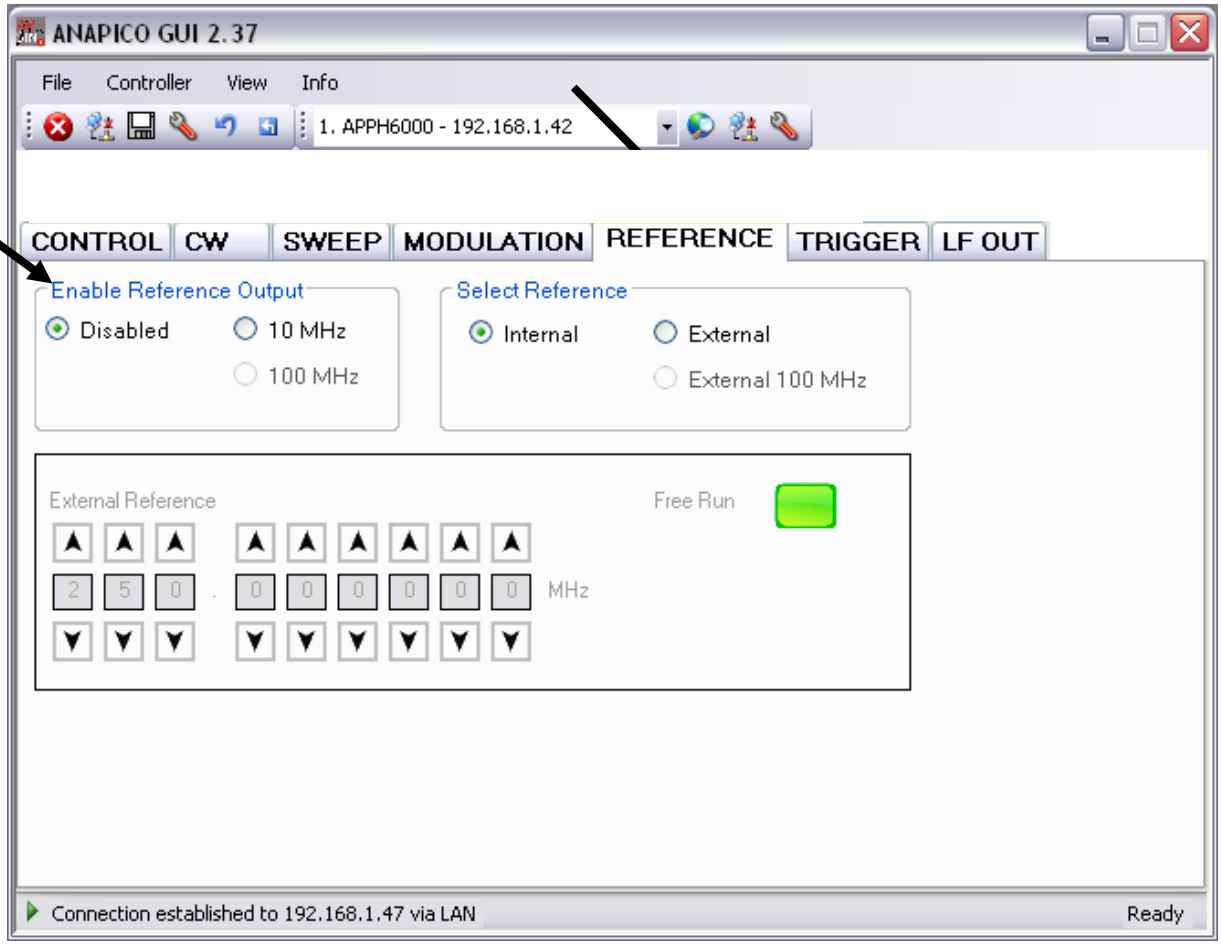


Figure 17 REFERENCE frequency setting

Using the Trigger options (Figure 18)

The BNC UNIT supports internal and external triggering for frequency, power, and list sweeps. To set the trigger options, go to the **TRIGGER tab** as shown in Figure 18.

Various trigger sources are available:

a) the "trigger key" which is the **RF on/off button**,

b) **LAN** (SCPI)

c) **external input** at the rear panel (currently shared with the pulse modulation input).

The **external TRIGGER** input should be a TTL logic signal.

The following trigger parameters can be defined:

a) **trigger delay**: 50 µs to 10 sec in 1 µs resolution predefined delay after trigger signal arrives. The trigger delay uncertainty is ±2 µs.

b) **trigger modulo**: N=1 to 255: defines every Nth trigger event to be used

c) **trigger active edge**: positive, negative and both (positive first or negative first)

d) **trigger occurrence**: single event or repeated

e) **trigger type:** single point, complete sweep, or gated

Confirm settings and arm trigger by pressing the **Apply** button.

As soon as a sweep is programmed, the output is disabled while the trigger is expected. Upon arrival of the trigger the sweep is executed (after given trigger delay). Any trigger signal arriving during execution of the sweep will be ignored.
If single sweep has been selected, the sweep will be executed only once as soon as first trigger signal arrives. As soon as the sweep is completed, the frequency will return to the preset CW frequency.
If repeat sweep is selected, the sweep will be executed every time the trigger signal arrives. After the sweep is completed, the frequency the RF output is disabled until next trigger arrives.
With **trigger type**, the user can select the trigger either to execute only a single point from the sweep or the complete sweep. When **gated** is selected the sweep is only executed while the trigger signal is high.

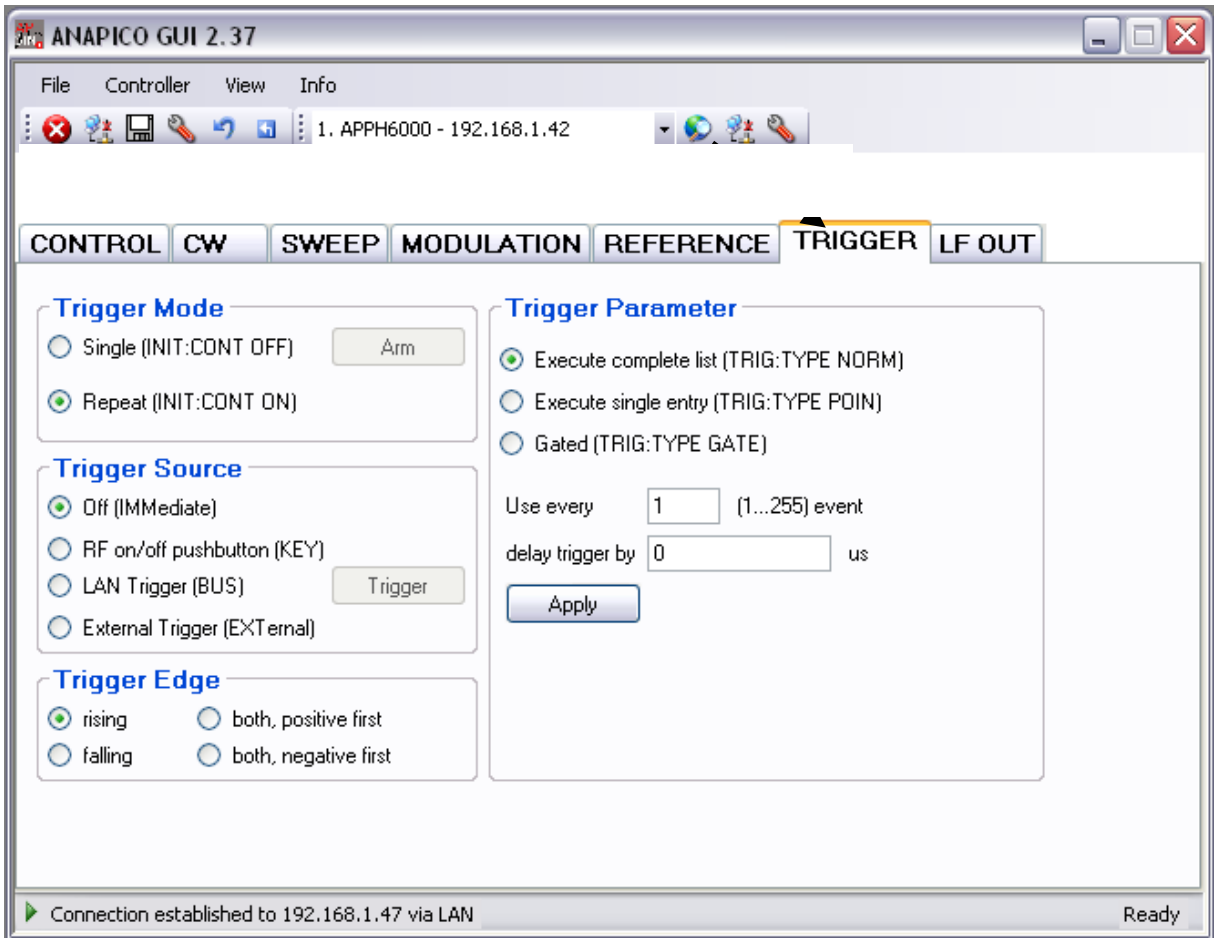


Figure 18 TRIGGER tab

LF OUT Control

The BNC UNIT rear panel output FUNCT OUT can be programmed using the LF OUT tab (Figure 19).

The FUNCT OUT output can be used as

- Video output of the internal pulse modulation signal
- Trigger output
- Output of the low frequency generator

In the GUI, select which output to be used and enable it by pressing the ON/OFF button.

The low frequency generator can output sine wave, triangle, or a square wave. The frequency can be set from 1 Hz to 5 MHz. The amplitude of the sine wave and triangle can be set for the sine wave and the triangle. If square wave is selected, the output is not affected by the amplitude settings and gives constant 5 Volts peak-peak amplitude.

The output impedance for sine and triangle wave output is 50 ohms, for square wave, trigger and pulse modulation video it is high impedance (CMOS and TTL logic compatible).

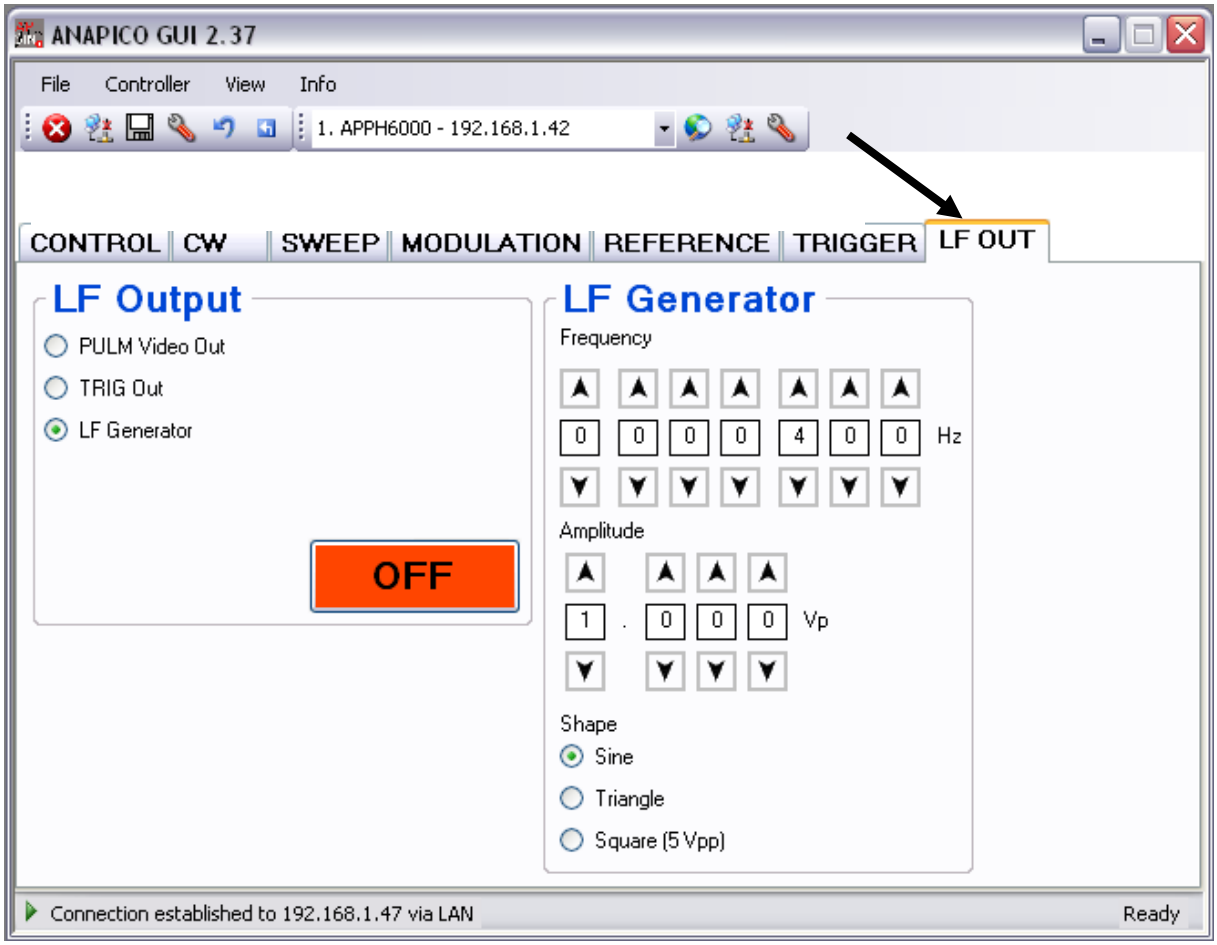


Figure 19 LF OUT tab

Combined Modulation

The table below shows what modulation types can be active simultaneously.

All modulation can be combined with frequency and power sweeps. For FM/PM, some timing restrictions apply. Check programmer's manual for further details.

Table 1: Possible combinations of internal and external modulation, and the internal LF generator output.

	FM/PM INT / EXT	**AM** INT / EXT	**PULSE** INT / EXT	LF Generator
FM/PM INTERNAL EXTERNAL		 YES / YES YES / YES	 YES / YES YES / YES	 YES YES
AM INTERNAL EXTERNAL			 NO/ NO NO/ NO	 NO YES
PULSE INTERNAL EXTERNAL				 YES YES
LF Generator				
CHIRP	NO/NO	YES/YES	YES/YES	YES

Notes:

4. Local Operation though Front Panel

With the HC option, the instrument is controllable directly from the front panel. Moreover, simultaneous control via front panel and GUI is possible.

The HC option adds keys and a rotary knob to the front panel. Figure 20shows the front panel view of the BNC UNITX000 with HC option.

Figure 20 BNC UNITX000-HC Front Panel View

RF On/Off button The **ON/OFF** key toggles between RF output on and RF output off. The green light is indicating whether the RF output is enabled (light on) or not.

RF 50 This female N- type connector provides the output for RF signals. The impedance is 50 ohm. The damage level is +30 dBm maximum. The maximum allowed DC level is +/- 10 V.

Rotary knob Varies the value at a cursor position (maked by the "_" symbol). Moves the entry cursor within the various submenus.

Menu Key This is a multifunction key. The key is used to enter and leave all the submenus displayed on the screen.

↓↑→← Keys These keys are used to move cursor within the screen menus.

LAN LED illuminates as soon a remote connection via LAN is active.

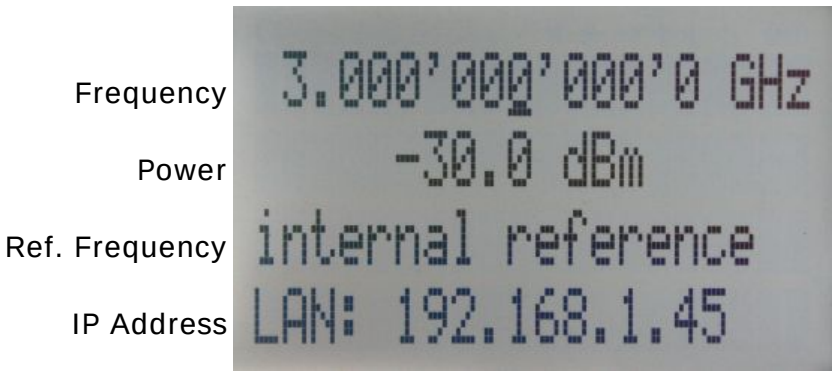
Power LED illuminates when system is powered up.

Displayed Parameter Formats

This section describes how to edit the frequency and amplitude and how to invoke the remaining functions of the BNC UNITX000-HC in local mode.

CW Display

The Main or CW Display is shown after the instrument has successfully booted and is ready. The four line display has the following format:



The currently active display position is shown by the cursor (underline symbol). The cursor does not move beyond the field of the currently selected parameter. Rotate the front panel knob to modify the value. Clockwise rotation increases the parameter and counter-clockwise rotation decreases the parameter. The parameter value will continue to increase or decrease by the amount of the selected resolution until it reaches the maximum or minimum limit of the parameter.

Use the up and down keys (↓ ↑) on the front panel to switch between frequency and power. Use the left and right arrow keys (→ ←) to select the active digit. The resolution step size is selected by positioning the cursor at the appropriate digit and then turning the front panel **rotary knob**.

.

Main Menu Display

The Main Menu Display is invoked my pressing the **menu key**. The main menu contains eleven submenus as shown below.

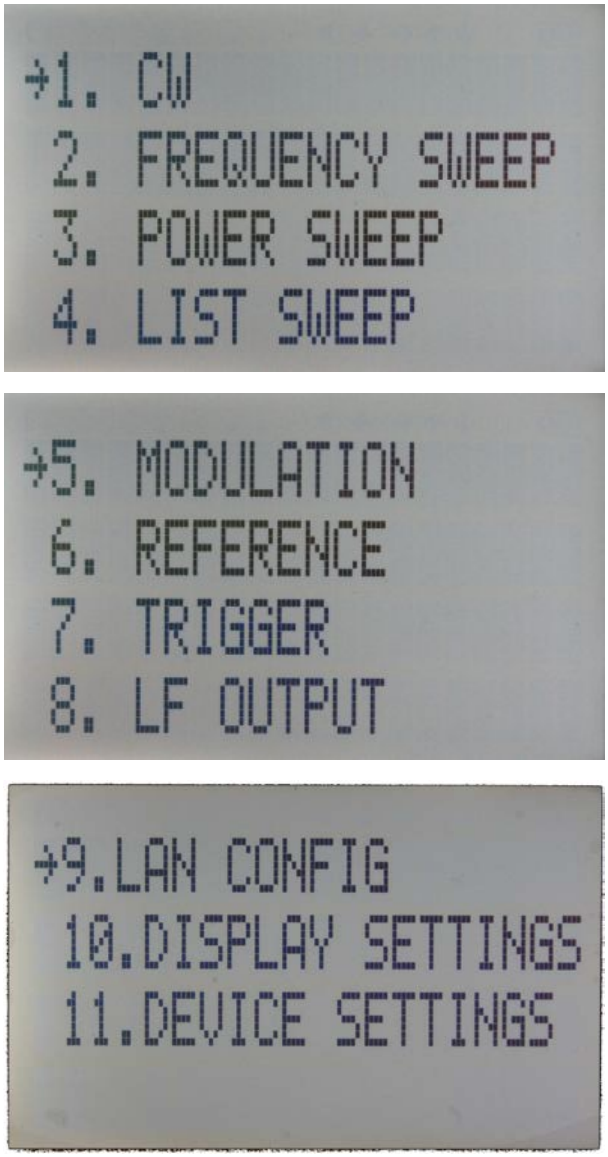


Figure 21 *Overview of the submenus available on the display.*

Use the up and down arrow keys (↓ ↑) or the **rotary knob** on the front panel to scroll the main menu. The arrow on the left displays the selected position. To enter a submenu, move the arrow (displayed at the left of the menu points) to the desired menu position and press the **menu key**.

Frequency Sweep Submenu

After accessing the Frequency Sweep menu, first of three displays allows to enter the start and stop frequency by using the → ← keys to select the digits and using the **rotary knob** to increase and decrease their values. Use the ↓ ↑ arrow to move between the several displays that contain settable sweep parameters. On the second display, the number of points, and the on and off time can be entered. On the third screen, select the sweep mode between LINear, LOGarithmic, and RANDom. Also select the repetition mode between INFinite, and 1 (single repetition).

Start the sweep by pressing the **RF On/Off button**. The submenus can always been exited (without starting the sweep) by pressing the **menu key**.

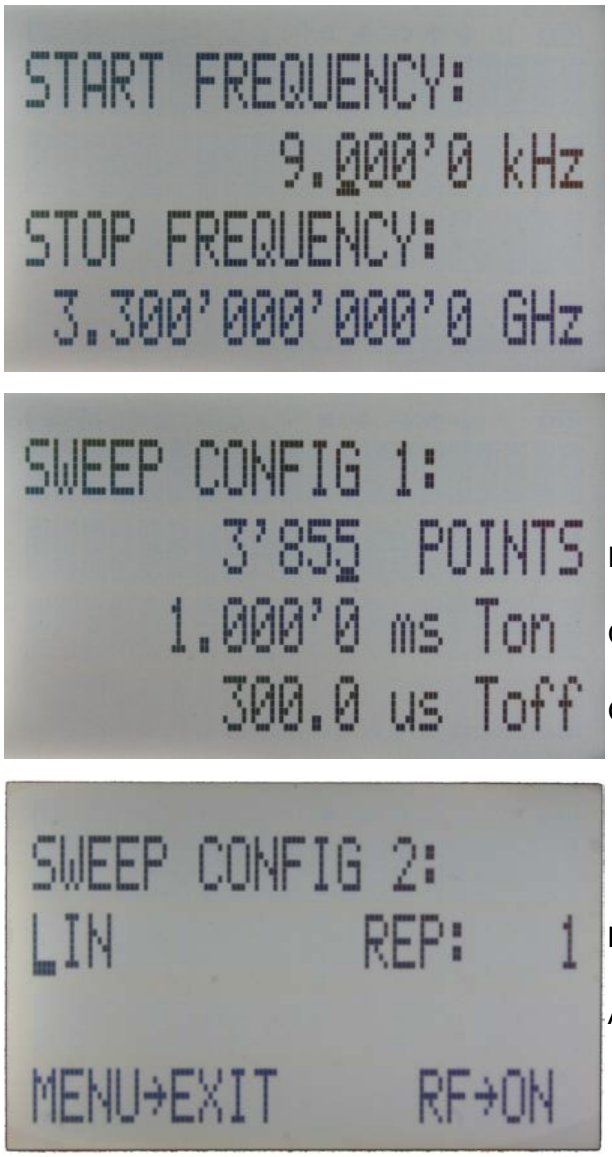
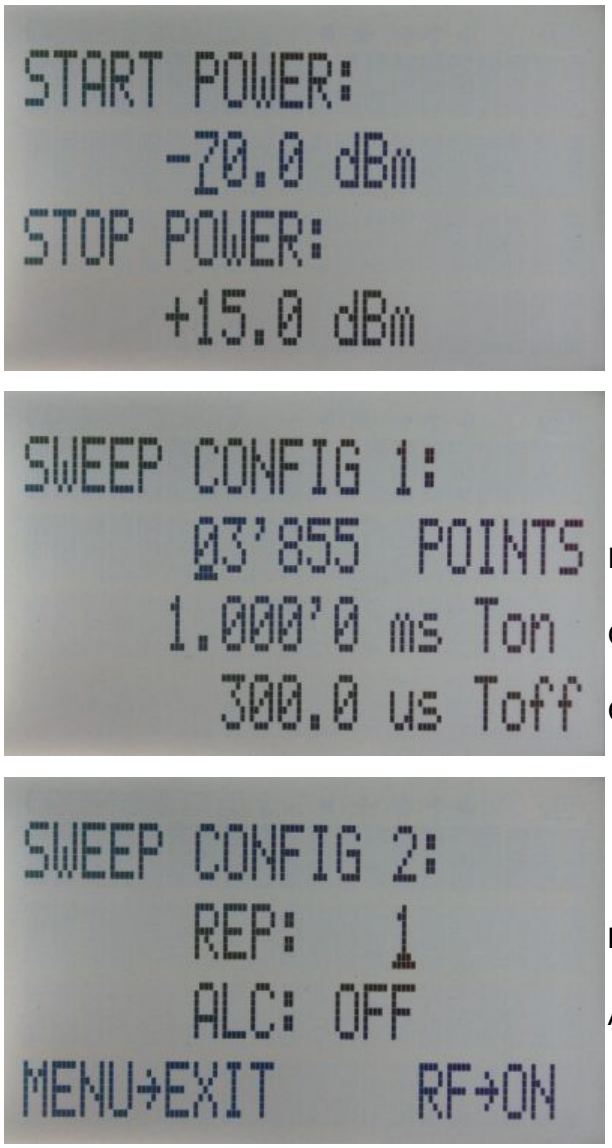


Figure 22 Displays shown for the frequency sweep configuration

Power Sweep Submenu

After accessing the Power Sweep menu, the first of total three displays allow to enter start and stop power by using the → ← keys to select the digits and using the **rotary knob** to increase and decrease their values. Use the ↓ ↑ arrow to move between the several displays that contain settable sweep parameters. On the second display, the number of points, and the on and off time can be entered. On the third display, select the repetition mode between INFinite, and 1 (single repetition).

Start the sweep by pressing the **RF On/Off button**. The submenu can always been exited (without starting the sweep) by pressing the **menu key**.



Number of Points per Sweep

On (dwell) time

Off time

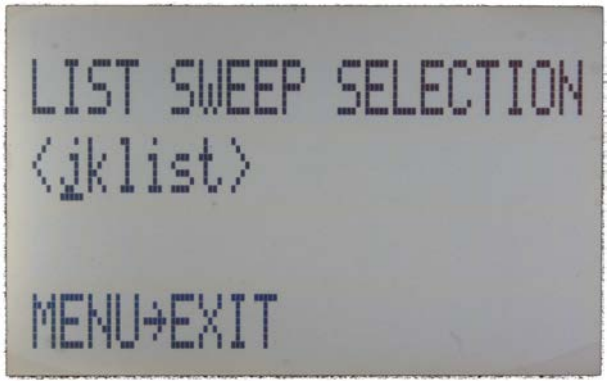
Repetition

ALC on/off

Figure 23 *Displays shown for the power sweep configuration*

List Sweep Submenu

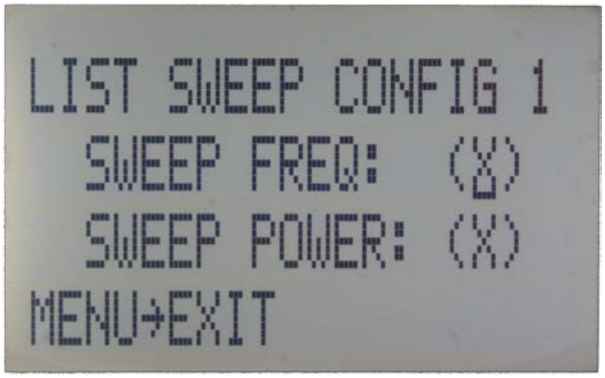
When entering the List Sweep submenu, a list of stored list sweeps is displayed.



After accessing the List Sweep submenu , the first of total two displays allow to enter start and stop power by using the → ← keys to select the digits and using the rotary knob to increase and decrease their values. Use the ↓ ↑ arrow to move between the several displays that contain settable sweep parameters. On the first display the number of repetitions of the list can be entered, and the ALC can be set on or off.

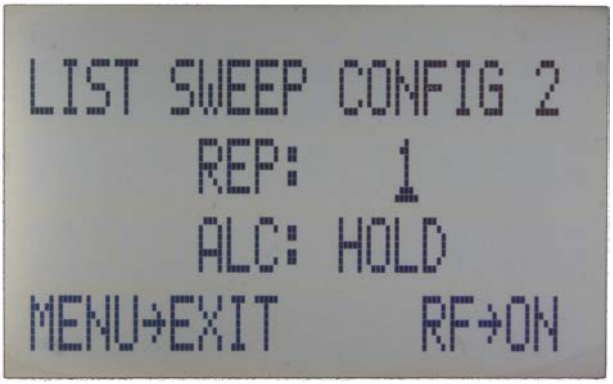
On the second display, a particular list can be selected from the flash memory of the device.

Start the sweep by pressing the **RF On/Off button**. The submenu can always been exited (without starting the sweep) by pressing the menu key.



Sweep Freq

Sweep Power



Repetition

ALC on/off

Figure 24 Displays shown for the list sweep configuration

Important note: **All sweeps must be started with the RF on/off button on (green light illuminated), otherwise no signal will be output during the sweep.**

Modulation Submenu

After accessing the Modulation menu, use the ↓↑ arrow keys to select the desired submenu entry. Press the **menu key** to enter the selected submenu. Choose EXIT to return to the main menu.

Pulse Modulation

Amplitude Modulation

Frequency Modulation

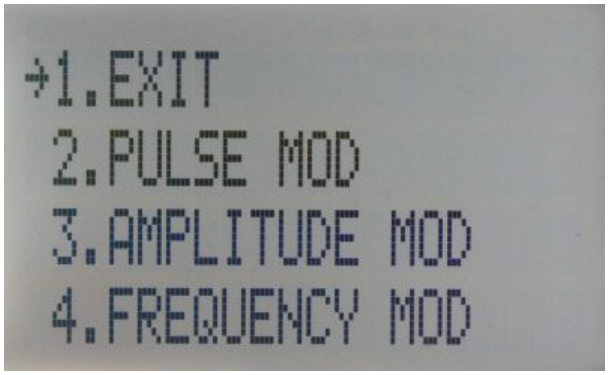


Figure 25 Modulation submenu.

Pulse Mod Submenu

In the Pulse Mod submenu the pulse modulation can be accessed. Use the ↓↑ arrow keys to move the cursor to the parameter that you want to change. Use the → ← and **rotary knob** to modify the parameters.

On line 1, select between INT (internal pulse generator) and EXT (external input).

If internal modulation (INT) is selected, go to line 2 to change pulse width to desired value, and go to line 3 to change pulse modulation frequency.

Enable modulation by pressing the **RF On/Off button**.

Exit the submenu by pressing the **menu key**.

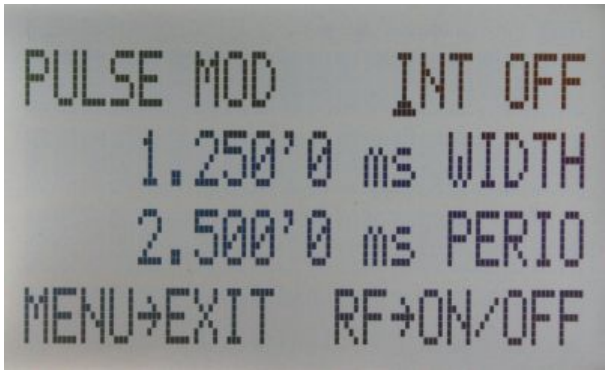


Figure 26 Pulse Modulation submenu

Amplitude Mod Submenu

In the Amplitude Mod submenu the internal amplitude modulation can be accessed. Use the **rotary knob** to set the modulation rate between 1 Hz and 10 kHz.

Enable modulation by pressing the **RF On/Off button**.

Exit the submenu by pressing the **menu key**.

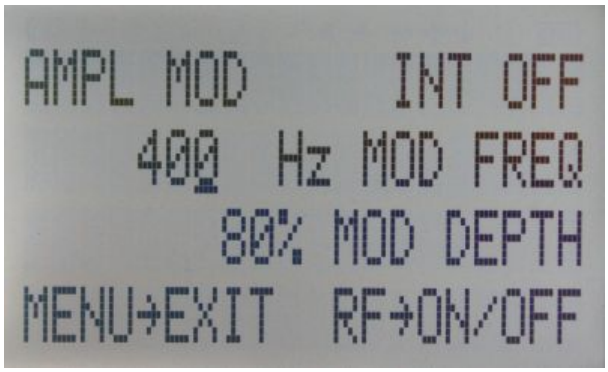


Figure 27 Amplitude Modulation submenu

Frequency Mod Submenu

In the Frequency Mod submenu the external frequency modulation can be accessed. Enable modulation by pressing the **RF On/Off button**.

Exit the submenu by pressing the **menu key**.

Figure 28 Frequency Modulation submenu

Reference Submenu

After accessing the Reference menu, use the ↓↑ arrow keys to move the cursor between the ON/OFF entry and the reference frequency entry. Use the **rotary knob** to toggle between ON and OFF, or to change reference frequency to the desired value, respectively. The display shows up as follows

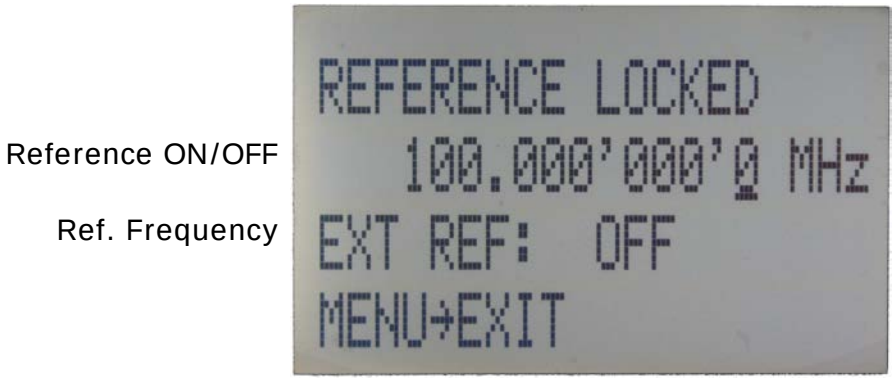


Figure 29 *Reference submenu.*

Confirm the setting by exiting the menu (pressing the **menu key**).

Trigger Submenu

After accessing the Trigger menu, use the ↓ ↑ → ← arrow keys to move cursor between the various menu entries. Use the **rotary knob** to toggle the selected entry value or to change selected digit. The display shows up as follows.

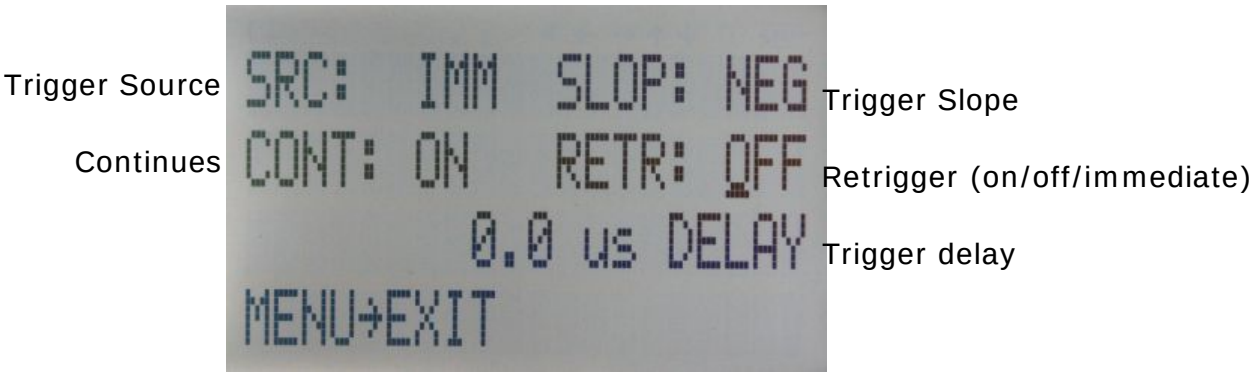


Figure 30 *Trigger submenu.*

Select SOURce: IMMediate, EXTernal, BUS (SCPI command), KEY (RF on/off button)
Select SLOPe: POSitive, NEGative
Select CONTinuous: ON, OFF (ON means that the trigger is re-armed after each trigger occurance)
Select RETRigger: OFF, ON, IMMediate (OFF means that any trigger event during execution of list is ignored)
Enter DELAY: trigger delay in microseconds.
Press the **RF On/Off button** to arm the trigger. Exit the menu by pressing the **menu key**.

LF OUTPUT Submenu

In the LF OUTPUT Submenu the FUNCT OUT output at the rear panel of the instrument can be configured.

Press the **RF On/Off button** to turn the output on and off. Exit the menu by pressing the **menu key**.

On the first screen the source for the FUNCT OUT can be selected. Choose LFG for the low frequency generator, TRIG to enable the internal trigger output, and PULM to enable the pulse video output. If LFG is selected, use the ↓ arrow to proceed to the second display. Select waveform between sine, triangle, or square. Then enter the desired output frequency and voltage amplitude.

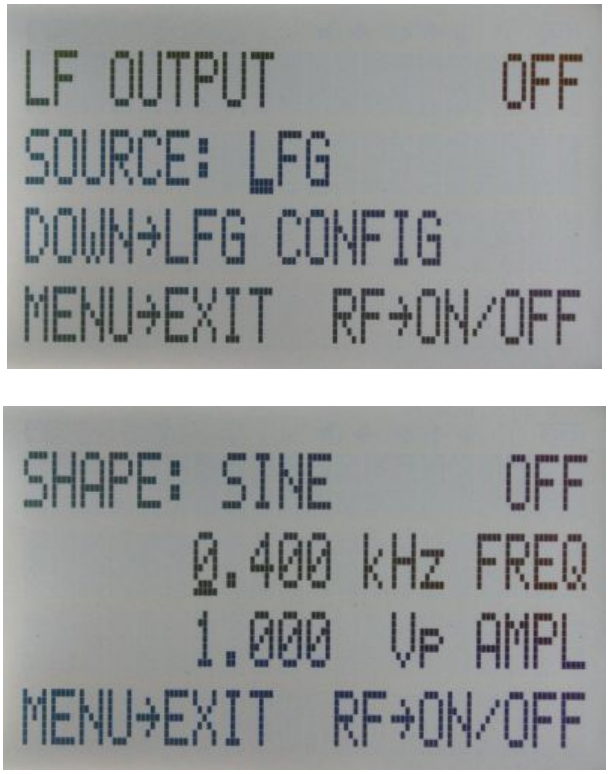


Figure 31 Displays shown in the LF OUTPUT submenu

LAN Configuration Submenu

After accessing the LAN Configuration menu, use the ↓↑ arrow keys to move cursor between IP address and submask address. Use the **rotary knob** to change selected digit. The display shows up as follows.

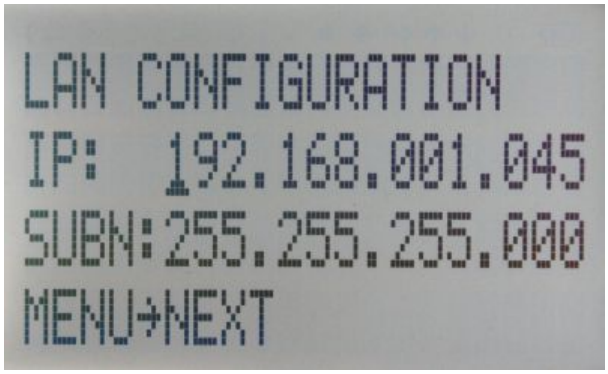


Figure 32 *LAN configuration submenu (display 1).*

Once you have done changes as required, press the **menu key** to continue the configuration to the second display. The display shows up as shown below:

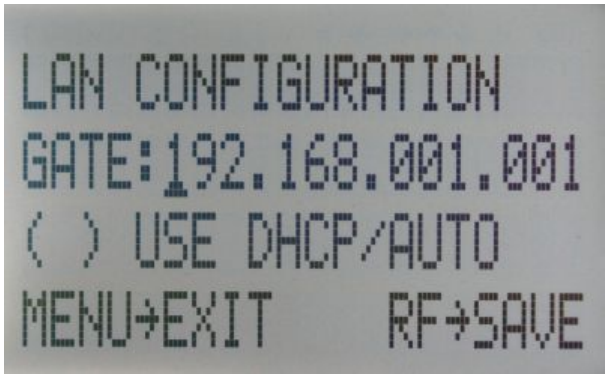


Figure 33 *LAN configuration submenu (display 2).*

Use the **rotary knob** either enable (x) or disable ( ) DHCP. Finally, press the **RF key** to save the configuration (don't if you want to discard your changes). Press the **menu key** to exit the LAN submenu.

Display Settings Submenu

After accessing the Display Configuration menu, use the **rotary knob** to change the display contrast as required. Press the **menu key** to save and exit the Display Settings submenu.

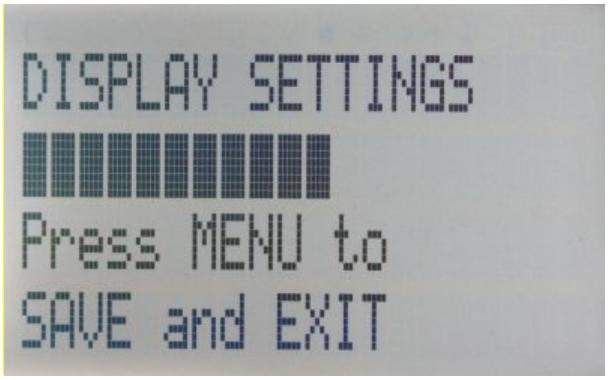


Figure 34 *Display settings submenu.*

Default Settings Submenu

After accessing the Default Configuration menu, use the **rotary knob** to

Settings submenu.

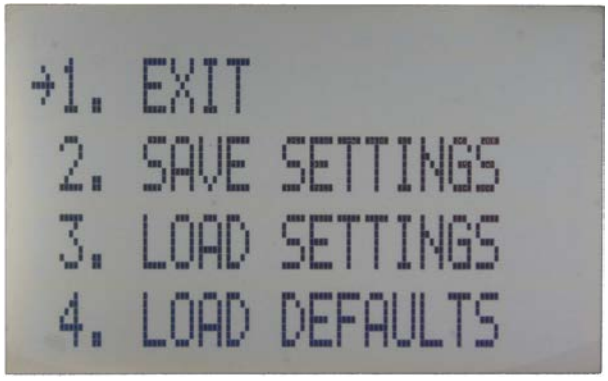


Figure 35 *Default settings submenu.*

Figure 36 *Save startup settings*

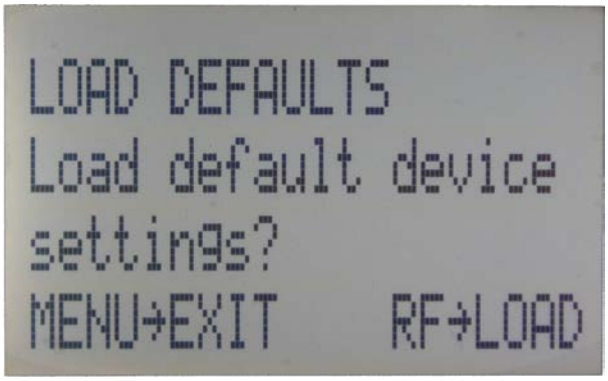


Figure 37 *Restore startup settings*

5. Programming the BNC UNIT

The signal generator can be remotely programmed via a 10/100/1000Base-T LAN interface and LAN-connected computer using one of several LAN interface protocols. The LAN allows instruments to be connected together and controlled by a LAN- based computer. LAN and its associated interface operations are defined in the IEEE 802.2 standard.

The BNC UNITX000 support the following LAN interface protocols:

1) **Socket based LAN:** proprietary function calls defined in the dynamic link library (DLL) provided with the instrument, used for general programming using the LAN interface under Windows operating system.
2) **VXI-11/SCPI** (version 1999) commands (firmware 2.0 upwards)
3) **Telephone Network** (TELNET): TELNET is used for interactive, one command at a time instrument control

For LAN operation, the signal generator must be connected to the LAN, and an IP address must be assigned to the signal generator either manually or by using DHCP client service. Your system administrator can tell you which method to use. (Most current LAN networks use DHCP.)

DHCP Configuration

If the DHCP server uses dynamic DNS to link the hostname with the assigned IP address, the hostname may be used in place of the IP address. Otherwise, the hostname is not usable.

Using Sockets LAN

Sockets LAN is a method used to communicate with the signal generator over the LAN interface using the Transmission Control Protocol/Internet Protocol (TCP/IP). A socket is a fundamental technology used for computer networking and allows applications to communicate using standard mechanisms built into network hardware and operating systems. The method accesses a port on the signal generator from which bidirectional communication with a network computer can be established. Sockets LAN can be described as an internet address that combines Internet Protocol (IP) with a device port number and represents a single connection between two pieces of software. The socket can be accessed using code libraries packaged with the computer operating system. Two common versions of socket libraries are the Berkeley Sockets Library for UNIX systems and Winsock for Microsoft operating systems.

Your signal generator implements a sockets Applications Programming Interface (API) that is compatible with Berkeley socket for UNIX systems, and Winsock for Microsoft systems. The signal generator is also compatible with other standard sockets APIs. The signal generator can be controlled using predefined SCPI functions (available from firmware 2.0 upwards) use the socket connection established in your program. Socket connection is available on port **18**.

Using and Configuring VXI-11

The signal generator supports the LAN interface protocol described in the VXI- 11 standard. VXI- 11 is an instrument control protocol based on Open Network Computing/Remote Procedure Call (ONC/RPC) interfaces running over TCP/IP.

A range of standard software such as NI-VISA or Agilent IO Config is available to setup the computer/signal generator interface for the VXI- 11 protocol. Please refer to the applicable software user manual and documentation for information on running the program and configuring the VXI-11 interface. The program is used to configure the LAN client. Once the computer is configured for a LAN client, you can use the VXI- 11 protocol and the VISA library to send SCPI commands to the signal generator over the LAN interface. Example programs are available on request under support@Berkeley Nucleonics.com.

VISA is an IO library used to develop IO applications and instrument drivers that comply with industry standards. It is recommended that the VISA library be used for programming the signal generator. The NI-VISA and Agilent VISA libraries are similar implementations of VISA and have the same commands, syntax, and functions.

Using SCPI for BNC UNIT

The Standard Commands for Programmable Instrumentation (SCPI) provides a uniform and consistent language to control programmable test and measurement devices in instrumentation systems. The SCPI Standard is built on the foundation of IEEE-488.2, Standard Codes and Formats. It requires conformance to IEEE-488.2, but is pure software standard. SCPI syntax is ASCII text, and therefore can be attached to any computer test language, such as BASIC, C, or C++. It can also be used with Test Application Environments such as LabWindows/CVI, LabVIEW™, or Matlab®. SCPI is hardware independent. SCPI strings can be sent over any instrument interface. It works equally well over GPIB, RS-232, VXIbus or LAN networks.

Please see the BNC UNITX000 Programmer's Manual V 1.2 for detailed description of supported SCPI commands.

Using Telnet LAN

Telnet provides a means of communicating with the signal generator over the LAN. The Telnet client, run on a LAN connected computer, will create a login session on the signal generator. A connection, established between computer and signal generator, generates a user interface display screen with ">" prompts on the command line.

Using the Telnet protocol to send commands to the signal generator is similar to communicating with the signal generator over LAN. You establish a connection with the signal generator and then send or

receive information using predefined commands. SCPI commands are supported from firmware version 2.0. Communication is interactive: one command at a time. The telnet service is available on **port 18**.

Please see the BNC UNIT Programmer's Manual for further details.

6. Battery Operation (B3 Option)

If your BNC UNITX000 is equipped with an internal rechargeable battery (B3 option) it can be operated without the external power supply. Fully charged, the battery is good for up to three hours of operation at full RF output power. The same external power adaptor (6 V @ 3 A) is used for the battery version as for the standard BNC UNITX000 for both normal operation and charging of the battery.

There are four operating modes that are also summarized in Table 2 below:

normal operation– the external power supply is connected to the BNC UNITX000 and the device is turned ON (with the power switch on the rear panel turned ON). In this mode the BNC UNITX000 can be used as if no battery was present. The internal battery is not used and will NOT be charged.

charging – the external power supply is connected to the BNC UNITX000 and the device is turned OFF (with the power switch on the rear panel turned OFF). In this mode the BNC UNITX000 is charging the internal battery. Once the battery is fully charged, the BNC UNITX000 goes into standby mode. The time required to complete charging is approx. four hours.

standby – the internal battery is fully charged and the BNC UNITX000 is turned OFF.

battery operation – the external power supply is disconnected and the device is turned ON. The internal battery is supplying the power until it is exhausted.

Table 2: Operating modes of an BNC UNITX000 equipped with internal battery

External power adaptor / Power Switch	supplying power	disconnected
ON	Normal operation (no charging)	Battery operation - until discharged (1)
OFF	Charging – when fully charged → standby (2)	Completely powered off

Notes:

(1) The BNC UNITX000 will switch off automatically when the battery is discharged. It is recommended that the power switch be turned to the OFF position when the battery is fully discharged.

(2) Termination of charging is automatic, the unit will then enter standby mode. The power adaptor can be left connected for any length of time.

During operation, the approximate remaining battery capacity is indicated by the battery symbol visible in the upper right corner of the display.

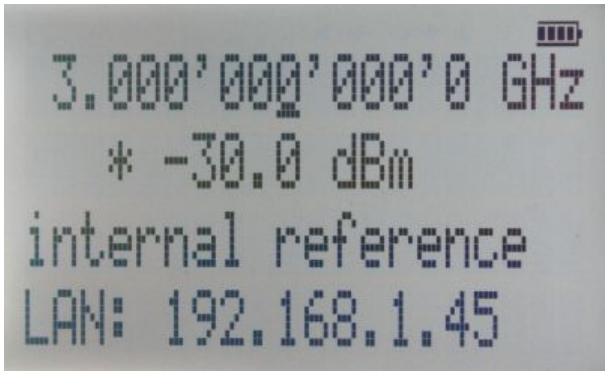


Figure 38 CW Display with Battery Symbol

Hints for maximizing the battery running time:

1. Fully charge the unit before use. For this, toggle the power switch to ON and then OFF again while the BNC UNITX000 is powered by the external power adaptor. This will initiate a new charge cycle.
2. Charging time of a completely discharged battery can be up to 6 hours. The battery will only be charged when the BNC UNITX000 power switch is in the OFF position.
3. Batteries should always be charged at room temperature. Charging the BNC UNITX000 at very low or at elevated temperatures may result in early termination of the charging process, i.e the battery is not fully charged. For safety reasons, the charging does not start when the internal temperature of the instrument is above 50 °C.
4. Check the battery indicator in the upper right corner of the display, it should indicate full charge when running on battery power after charging (4 segments).
5. Power consumption of the BNC UNITX000 is reduced when the RF power is switched off thereby increasing overall battery run time.
6. Battery run time is maximum for ambient temperature between 15 and 25 °C. Self-discharge of the battery is much faster at temperatures above 30 °C.
7. Avoid storing the BNC UNITX000 in very hot places such as behind the windshield of a car parked in the sun.

Hints for maximizing battery life expectancy:

1. The battery will reach its best performance after the first few charge-discharge cycles.
2. Always use the external power adaptor supplied with the BNC UNITX000 for normal operation and charging. This will make sure that the charging circuits work as specified.

3. Fully charge the BNC UNIT after running it from the battery for an extended period of time.
4. If an BNC UNIT with internal battery will be stored for a long period of time, fully charge it before storage, then remove the power adaptor and make sure that the power switch is in the OFF position. After storage, first charge the unit for 4-6 hours.

To replace the battery at the end of its lifetime, please contact Berkeley Nucleonics or one of its distributors.

◆ **Before using the BNC UNIT in battery mode for the first time, the battery must be fully charged.**

◆ **Batteries must be disposed off according to the local environmental regulations.**

7. Extended Power Range (PE3 Options)

Both the BNC UNIT 835-6 and the BNC UNIT 845 are available with options extending the power range towards lower power levels.

With these options installed, the minimum settable power level in CW operation is extended down to –130 dBm (BNC UNIT 835-6) and -100 dBm (BNC UNIT 845). For the guaranteed minimum power level, please consult the respective datasheet.

In **POWER SWEEP** Mode, the user shall avoid running sweeps over large power ranges (> 30 dB) for extended periods of time, as this will result in continuous switching of the mechanical attenuators and thus reduce the lifetime.

In sweeps where the mechanical attenuator is switched, the minimum dwell time increases to 20 ms.

8. Maintenance and Warranty Information

Adjustments and Calibration

To maintain optimum measurement performance, the BNC UNITX000 should be calibrated every 24 months. It is recommended that the BNC UNITX000 be returned to Berkeley Nucleonics or to an authorized calibration facility. For more information please contact our Customer Service Department at support@Berkeley Nucleonics.com or by phone (+4144) 440 00 51.

Repair

The signal generator contains no user-serviceable parts. Repair or calibration of the signal generator requires specialised test equipment and must be performed by Berkeley Nucleonics or its authorized repair specialists.

Safety

FCC notice

This equipment has been tested and found to comply with the limits for a Class A device, pursuant to **Part 15 of the FCC Rules**. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Operation of this equipment in a residential area may cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

CE notice

The BNC UNIT Signal Generator meets the intent of the **EMC directive 89/336/EEC** and have been designed to **EN61326 Class A Emissions and Immunity** standard.

The BNC UNIT also meets the intent of the **Low Voltage Directive** and have been designed to meet the **IEC 61010-1:2001** (safety requirements for electrical equipment, control, and laboratory use) standard.

Warranty Information

All Berkeley Nucleonics instruments are warranted against defects in material and workmanship for a period of **two years** from the date of shipment. Berkeley Nucleonics will, at its option, repair or replace products that prove to be defective during the warranty period, provided they are returned to Berkeley Nucleonics and provided the preventative maintenance procedures are followed. Repairs necessitated by misuse of the product are not covered by this warranty. No other warranties are expressed or implied, including but not limited to implied warranties of merchantability and fitness for a particular purpose. Berkeley Nucleonics is not liable for consequential damages.
The warranty on the internal rechargeable batteries (option B3) is one year from the date of shipment. Battery replacement is available through Berkeley Nucleonics and its distributors.

Equipment Returns

For instruments requiring service, either in or out of warranty, contact your local distributor or Berkeley Nucleonics Customer Service Department at the address given below for pricing and instructions before returning your instrument.
When you call, be sure to have the following information available:

- Model number.
- Serial number.
- Full description of the failure condition.

Note: Model and serial number can be found on the rear of the BNC UNITX000 unit, next to the power plug.

You will get a Return Mechandise Authorization (RMA) number from Berkeley Nucleonics, please put it on the outside of the package.
Instruments that are eligible for in-warranty repair will be returned prepaid to the customer. For all other situations the customer is responsible for all shipping charges. An evaluation fee may be charged for processing units that are found to have no functional or performance defects.
For out of warranty instruments, Berkeley Nucleonics will provide an estimate for the cost of repair. Customer approval of the charges will be required before repairs can be made. For units deemed to be beyond repair, or in situations where the customer declines to authorize repair, an evaluation charge may be assessed by Berkeley Nucleonics.

Company Details

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